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NOTES FOR THE MONTH.

Agricultural Credit Societies.

THE scheme for the formation of Agricultural Credit Societies under Section 2 of the Agricultural Credits Act has made little progress up to the present. One obstacle has been the rate of interest on advances by the Ministry to societies, which on the initiation of the scheme was fixed at 5 per cent. This has now been reduced to current Bank Rate with a minimum of 4 per cent., so that this obstacle has been removed. A leaflet has been issued explaining the method of forming societies, and if the scheme outlined in the leaflet were taken up it should prove of great advantage to small farmers and others in enabling them to purchase live stock and requirements on extended credit. It is not usually practicable or desirable for a society to be formed exclusively of prospective borrowers, and the method suggested in the leaflet is that such societies can best be promoted through the agency of existing co-operative societies or other organisations, who will take up shares in the Credit Societies without being actual borrowers. Under such an arrangement the share capital subscribed by the co-operative society, or other organisation, combined with the shares taken up by prospective borrowers and with the proportionate Government advance, would put the society on a sound footing.

The following extracts from the leaflet may be quoted:—

The method provided by the Act involves the establishment of Agricultural Credit Societies which are financed partly by the paid-up capital on shares taken by members and partly by money advanced by the State.

Although the Government advance to a society under the Act is on a very liberal scale, it must be remembered that a society cannot, as a rule, be formed exclusively by borrowers.

This difficulty can be got over either by inducing persons to take shares in the society who do not themselves wish to obtain loans, or by each member taking more shares. As the

ing loans will not usually wish to invest more money in the society than is necessary, the former method is the one which must in ordinary cases be adopted.

As it may not always be easy to find persons who, without any direct benefit to themselves, are willing to invest money in Co-operative Credit Societies, the Ministry think that the most hopeful method of proceeding is through existing Co-operative Trading Societies. The object of the loan in the majority of instances will be to enable the borrower to purchase agricultural requisites such as fertilisers, seeds, live stock, implements, etc., and the natural course is to adapt the scheme to the ordinary conditions of trade so that the loan and the purchase (which is the object of the loan) are made through the same channels at the same time.

This can be accomplished where a Co-operative Trading Society is prepared to promote a Co-operative Credit Society and to take up shares in it proportionate to the anticipated demand. In such a case a member of the Trading Society wishing to make a fairly extensive purchase of agricultural requisites could take shares in the Credit Society and by a book-keeping transaction would pay the Trading Society for his purchase, the amount being charged to him as a loan from the Credit Society. The adoption of the above proposal by Co-operative Trading Societies would be to the benefit of those farmers and small holders who wished to make purchases on a system of deferred payments as contemplated by the Act, and it would also seem to be to the advantage of Co-operative Trading Societies as it would in effect enable them to provide credit facilities for their customers on a larger scale than they would otherwise be able to offer.

Persons interested should apply to the Ministry for a copy of Leaflet No. 311.

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Loans to Agricultural Co-operative Societies.

A STATEMENT was given in the March issue of this *Journal* setting out the provisional conditions on which loans will be made by the Ministry to co-operative societies engaged in the preparation and marketing of agricultural produce.

The Ministry is now prepared to receive applications, and organisations which desire to make application should apply for a form which indicates the particulars which are required in order to enable the Ministry to consider the matter.

Power Farming: Model Demonstration at the Wembley Exhibition.

A MODEL which is to be exhibited in the Government Pavilion at the British Empire Exhibition by the Machinery Branch of the Ministry, illustrates up-to-date methods of power farming and a modern type of farm buildings. While the exhibit cannot claim to be exhaustive, it serves as a useful indication of the use of mechanical power for the several field operations, and the utilisation of electricity for operating farm machinery and for other purposes.

The field operations shown include ploughing with steam tackle, a method of which Great Britain may perhaps with justice claim to be the home. The tractor will also operate ploughs, including sub-soiling ploughs.* While the practice of sub-soiling is not new, much yet needs to be investigated both as to the best methods of dealing with "hard-pan" soils and the relative merits of sub-soiling proper, which disturbs the under-soil without bringing it up, and deep-ploughing, which bring the lower soil to the surface. The tractor will also be seen working two mowers, a method which trials, conducted in 1922, proved to be very economical on fairly large areas.

It will further be seen with a hay-loader and, as an object lesson of what will not pay, with a single binder. A single binder is not a sufficient load for a tractor, and when a tractor is not working up to its full capacity there is necessarily a waste of fuel. The draw-bar pull for two binders in a heavy crop of wheat is approximately 1,250 lb., which is well within the capacity of the average tractor. A tractor with two binders, given a field sufficiently large for their operations, may be expected to effect a saving of about 15 per cent.

The tractor will also be shown operating a mole-plough which gives occasion for an exhibit illustrating the benefits of drainage generally, whether the less expensive process of mole-ploughing, or the more costly, but highly remunerative method of tile draining be adopted. Two miniature plots will be included, one drained, the other undrained, and the effects of a system of drainage on the hay crop will be demonstrated.

The other section of the exhibit—that which shows the farmstead—should prove particularly attractive. It is naturally impossible to prescribe any one type of arrangement as generally suitable. Much will necessarily depend on the natural

* Accounts of the trials in sub-soiling which are being conducted by the Ministry have appeared in the following issues of this *Journal*: Jan. 1923

features of the situation, something too on individual predilections. Again, the extent of the acreage to be served by the farmstead is an important point to be considered. The exhibit will illustrate the best methods of securing the three main essentials, both for man and beast, of light, ventilation and sanitation, and will give some indication as to how, by careful arrangement of all the various buildings, the most efficient and least costly working may be secured. The farmstead is arranged in the form of a rectangle or court—forming an open yard—rather to the back and to the side of the dwelling house. The dwelling house is shown facing south. It is equipped with a wireless installation for the receipt of weather reports, with a private telephone exchange connecting all the various buildings, and with electricity for lighting and heating.

The same care has been taken in the model as should be taken in actual practice in the arrangement of the dairy building. This is as it were a factory for the production of human food and the sanitary requirements of light, ventilation, drainage and cleanliness can never be too pointedly emphasised. The building (as careful observers will gather from the weathervane on the farmhouse) has its main axis lying north and south, this position being most convenient to ensure that as much direct sunlight as possible shall reach the stalls during the course of the day. The stall fittings are constructed of steel, with concrete mangers and floors.

To the casual observer of the ordinary farm nothing perhaps used to appear so neglected as the farm implements. These, however, are ceasing to be the simple inexpensive appliances which served our forefathers, and both on account of their cost, and in the interest of their prolonged efficiency, require careful and adequate housing.

The power-house, which is also shown, is quite a modern addition to the farm. The power will be provided, in this case, by a windmill of the Airolite type, provided with storage batteries. In the rickyard will be noticed a thrashing machine with stack-feeder and elevator driven by a tractor. Here also will be illustrated the new method of drying crops by artificial means, in which experiments were last year conducted by the Ministry. There will also be shown a model silo with silage cutter and blower elevator complete. The barnyard is provided with tramway tracks, with trolleys for the conveyance of food and manure.

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International Seed Testing Congress.

Arrangements are now well advanced for the fourth International Seed Testing Congress which is to be held in London and Cambridge during the second week of July next. Most of the principal countries in the world, and in particular those where an Official Seed Testing Station is established, have appointed official delegates to attend. The organisation of the Congress, which is on similar lines to that of the previous International Seed Testing Congress held at Copenhagen in 1921, is being carried out by a small Committee set up by the Ministry of Agriculture and Fisheries. Most of the meetings will take place at the National Institute of Agricultural Botany, Cambridge, and papers on various phases of seed testing will be contributed by certain of the delegates, and subsequently discussed. In addition, visits to the British Empire Exhibition at Wembley, Rothamsted Experimental Station at Harpenden, and the School of Agriculture and other places of interest in Cambridge will be organised.

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A Fine Milking Record.

Milk records which are taken under the auspices of the local societies operating in connection with the Milk Recording Scheme of the Ministry often show surprising results, and, as an illustration of what can be achieved by attention to records and care in management, the following case will commend itself.

Mr. T. Stuart, of New Hall, Sowerby, Garstang, Preston, a member of the Lancashire County Milk Recording Society, owns a non-pedigree Shorthorn cow, "Sowerby Doris," which was bred on the farm. Her sire is believed to have been a Cumberland bull of the Hegglesfoot breed. Contrary to his usual practice of selling cows when carrying their third or fourth calf, the owner decided to retain "Sowerby Doris" in order to test a remark which he had heard concerning this cow's sire, to the effect that the longer the progeny of this bull were kept the better milkers they would be. The following annual and lactation yields confirm the accuracy of this remark:—

	Days in Milk.	*Milk Yield (lb.).*
Year ended 1st October, 1918	274	5,759
" " " " 1919	256	6,370
" " " " 1920	172	6,695
" " " " 1921	246	5,745
" " " " 1922	340	17,897
" " " " 1923	220	12,857
Period from 1st October, 1923 to 3rd		

	Days in Milk.	Milk Yield (lb.)
2nd lactation, calf born 13th April, 1918 ...	244	5,382
3rd " " " 1st April, 1919 ...	235	6,282
4th " " " 3rd June, 1920 ...	362	11,997
5th " " " 22nd Oct'r, 1921 ...	424	19,066
6th " " " 13th May, 1923 ...	273	18,960

(This last yield was up to 3rd February, 1924, when she was still in milk and giving about 40 lb. per day.)

As will be seen from these returns the cow gave little promise in her early years of being a big milker, and the development is so marked as to be worthy of record. At the time of inspection the cow was reported to be in splendid condition and perfectly healthy, and was expected to pass the 2,000 gallon mark. Mr. Stuart has four other cows from the same sire which have all averaged over 1,000 gallons with their last four calves.

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Yields of Different Varieties of Lucerne.

IN the spring of 1922 the National Institute of Agricultural Botany, Cambridge, received samples of eight different stocks of Lucerne, namely, "Provence" lucerne grown respectively in France, South Africa, Essex, and Northamptonshire, and "Grimms," "Kansas Grown Common," "Dakota Grown Common," and "Peruvian" from America.

These were planted each in a single rectangular plot of one thirty-second part of an acre. Results obtained from single plots can never furnish conclusive evidence of the relative yields of different stocks, nor are two year's trials sufficient to furnish more than an indication of their comparative merits; but the results have been so consistent and of such practical interest that it is considered that a preliminary note should be published forthwith. A further inducement to its publication is furnished by the fact that the results coincide in all essentials with unpublished data received from Essex and Lancashire.

One cut only was obtained in 1922, while four cuts were taken in 1923. In each year "Provence" from Essex seed gave the biggest crop, followed by "Provence" from French seed, with that from Northampton-grown seed third. In 1922 South African-grown "Provence" came fourth, but in 1923 it did so badly that it dropped to seventh place, and its total yield for the two years is only a little over half of that of the average of the other three Provence stocks. "Grimms," which has created such a favourable impression in the United States owing to its hardiness, has not shown promise in the present trials,

starting its growth late and finishing early, and only taking fifth place in total yield.

The good showing made by English-grown stocks is interesting, but little can be hoped from this at the present time. It is only once in every five or six years that weather conditions in this country allow the harvesting of a seed crop of any of the existing forms of Lucerne, and in these circumstances the supply cannot be a large one.

It would appear, therefore, that unless plant breeders can procure, either by breeding or selection, a more rapidly maturing form of Lucerne without loss of yield, the farmer will be compelled, as heretofore, to rely on foreign seed. All the available evidence would suggest that buyers, when English-grown seed is unobtainable, should insist on seed grown in the Provence district of France as being the most suitable for sowing under English conditions.

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The Agricultural Index Number.

THE general level of prices of agricultural produce during February remained at the same figure as during January, 61 per cent. above the level in the corresponding month in the years 1911-13. In February last year prices were 63 per cent. above pre-war.

In the following table are shown the percentage increases monthly since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	—
April ...	202	149	70	54	—
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Cereals were all appreciably dearer in February than in January, and are between 40 and 45 per cent. above their value before the War; wheat and barley being considerably dearer than

half of February, but the general level of prices during the month was 170 per cent. above that of the corresponding month in 1911-1913, the full effect of the January advance being reflected in February prices. In February last year potatoes were selling at 5 per cent. below pre-war prices, averaging 73s. per ton as against 208s. this year. Hay remained at approximately its pre-war value.

Index numbers of fat stock of all descriptions show a fall, in spite of the fact that cattle and sheep averaged as much in February as in January; the lower index numbers are due to the fact that cattle and sheep prices normally rise slightly at this season. Fat stock would doubtless have shown a heavier fall but for the occurrence of the dock strike, which caused a temporary shortage of imported meat and a sharp rise in quotations for fat stock. Since the strike ended prices have declined. Pigs were relatively much cheaper than other fat stock in February, the fall as compared with a year ago being nearly 30 per cent.

Dairy produce showed little change on the month, the index number for cheese falling slightly, but that for butter rising. Poultry and eggs were cheaper, although the reduction in the index number for poultry is entirely due to the lower prices ruling for geese.

Index numbers of different commodities during recent months and in February, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. Feb.	1923. Oct.	1923. Nov.	1923. Dec.	1924. Jan.	1924. Feb.
Wheat ...	28	20	22	33	34	44
Barley ...	12	25	25	27	34	43
Oats	39	25	24	30	38	41
Fat cattle ...	61	44	47	49	56	54
Fat sheep ...	97	76	77	72	87	75
Fat pigs ..	88	48	47	43	43	34
Dairy cows ...	67	61	57	—	51	48
Store cattle ...	36	27	25	—	35	39
Store sheep ...	100	99	88	—	91	89
Store pigs ...	154	82	75	—	63	50
Eggs... ...	46	92	92	86	85	75
Poultry ...	80	65	58	77	60	52
Milk	90	72	75	90	87	87
Butter ...	72	61	64	68	68	71
Cheese ...	88	76	73	71	76	72
Potatoes ...	—5*	62	80	91	129	170
Hay	42	7	—1*	0	—1*	—1*

* Decrease.

AGRICULTURE AND HORTICULTURE AT THE BRITISH EMPIRE EXHIBITION.

Sir Lawrence Weaver, K.B.E.,
Director: United Kingdom Exhibits.

Of all the industries proper to be shown at a great international or inter-imperial exhibition, agriculture is necessarily the most difficult to present in an attractive and convincing fashion. Arable farming takes up more space than any exhibition could provide, and the difficulties are almost insuperable of keeping in an exhibition ground for the usual term, about six months, enough animals to be representative of a country's stock farming. It was done at one of the Paris exhibitions, but the experiment was not wholly satisfactory to those British breeders who sent stock, and the experiment has not been repeated. At Gothenburg last year an important agricultural show was held for a short period in grounds near those of the Jubilee Exhibition, but this was only the annual Swedish function like our Royal Show, enlarged and given an international flavour.

Last autumn it seemed likely that United Kingdom agriculture would be represented nowhere but in the British Government's Pavilion, and there only by the Ministry's official exhibits relating to research and education—that our farming community would take no part or lot in showing to the visitors from overseas how farming stands in the United Kingdom to-day. But, happily, the National Milk Publicity Council, with the co-operation of the National Farmers' Union, and some financial aid from the Development Fund on the Ministry's recommendation, decided to make a demonstration of ideal dairying methods.

The exhibit will be housed in a large and handsome building designed by Mr. Constantine and standing immediately to the south-east of the British Government Pavilion. It will fall under two heads:—production, and handling and manufacture. So far as production is concerned there will be shown an up-to-date cowshed, in which from 10 to 12 British Friesian cows will be stalled for the period of the exhibition. These cows will be utilised to illustrate the production of clean milk. At one end of this building will be a milk room equipped to show how such milk is cooled immediately after milking and, if necessary, bottled; also how all pails and equipment utilised on the farm should be washed and sterilised.

In the main building, which will be devoted to handling and

of handling liquid milk. The milk arriving in churns will be tested for quality and purity; it will then be transported by a lift to the top of the building where it will be emptied into a milk tank. From there it will flow to a pre-heater, clarifier, and pasteuriser, and from thence to a holding tank so that it may comply with the requirements of the Ministry of Health for "Pasteurised" milk.

From the holding tank the milk will descend over a cooler. It will then be shown being bottled, the bottled milk eventually finding its way to the cold store. The proper methods of washing and sterilising both churns and bottles will be illustrated also. The whole of the equipment used in this exhibit will be of "pasteurised" milk.

There will also be a working dairy in which demonstrations will be given and where the different varieties of cheese, clotted cream, and soft cheeses will be manufactured. An exhibit of all the different varieties of goods manufactured from milk in this country, including the various forms of hard cheeses, soft cheeses, cream, butter, milk chocolate, dried and condensed milk, and casein products will be arranged.

On the outside of the building the chief dairy breed societies will exhibit photographs of their respective breeds.

In the very notable exhibit of the gas undertakings in the Palace of Industry emphasis will be laid on sulphate of ammonia as our chief fertiliser of home production, and, though there is no segregated exhibit of agricultural machinery, there will be items of interest to farmers scattered throughout the great Palace of Engineering.

Those who are familiar with the experiments made by Mr. Borlase Matthews at Upper Felcourt, near East Grinstead, in the application of electrical power to the work of the farm will be interested in the exhibit of appliances and methods which Mr. Matthews is arranging for the Electrical Development Association on a site to the north of the Government Pavilion.

Poultry will be well represented by an exhibit organised jointly by the Poultry Club and the National Utility Poultry Society. The conception of this live display is to bring before the public a continuous exhibition of pure stock from the leading breeders of the United Kingdom, in a pavilion which is near the farming and forestry exhibits. The birds will be shown in separate compartments, each containing one female (or two) or one male. The names of the breeders and other particulars will be placed on each pen, and the birds will be changed week by week.

In addition to the live stock, which will be representative of all breeds, including ducks and bantams, there will be a small section including models, literature and minor appliances.

There will also be an important private exhibit by Major Dugdale, of Whiteway Farm, Cirencester. A large area will be laid out as a model utility poultry farm with pens of various breeds. Trap-nesting will be in operation, and the latest methods of chicken rearing will be on view. Chicks will be hatching continuously in a mammoth incubator, and the complete cycle of grading and recording will be seen. Major Dugdale will also show an extensive series of photographs of stock-raising and other farming activities.

Horticulture will be well represented, but more fully in respect of flower gardening than of food production. The gardens under the control of the Exhibition authorities have been laid out by Messrs. Milner, Son and White, and an area of nearly four acres adjoining the British Government Pavilion has been allotted to a group of nursery- and garden-making firms organised by a Horticultural Committee under the Chairmanship of Mr. Cuthbertson, V.M.H. I need only refer here to the food production activities that will be shown. There will be small model commercial fruit orchards, representing a two-year planting that is about to come into bearing. The majority of the trees will be low-stemmed and all should be in flower by the opening of the Exhibition, and it is hoped, with good fortune, in fruit by its close. A feature will be made of cordons, and of the inter-planting of soft fruit. A film showing all the operations of commercial orcharding in this country, from planting to marketing, will be on view in the British Government Pavilion.

Nor has forestry been forgotten. A committee, with Lord Lovat as chairman, secured the co-operation of the various societies interested in the development of forestry and the uses of home-grown timber, and has built for England a replica of a sixteenth century timber house, and for Scotland a simple pavilion designed by Sir Robert Lorimer of a type suitable for use as a village hall. These two buildings will be furnished with exhibits illustrating the possibilities of using home-grown timber in many ways, which the vast importation of foreign timbers has made people forget.

I need not enlarge on the Ministry's exhibit in the British Government Pavilion, as its scope was described in the last issue of the *Journal*; but it will make clear the fact that everything that can reasonably be done is being done to promote a solution

agriculture. Writing with the freedom which belongs to a former servant of the Ministry, and with such experience as comes to one who for five years has occupied the chair of one of the institutions whose activities will be staged by the Ministry, I may be allowed here a parenthetic remark on the relations of Governments and Ministries to agricultural science. I believe that since the war the development of scientific service to agriculture has been fostered as rapidly and as fully as could reasonably be expected, having regard to the size and quality of the corps of agricultural scientists available for the services to be performed, whether in education or in research. I am not persuaded that if another million or so had been available during the last five years, the mechanism of research in the United Kingdom, and the results of research work to be presented to the Empire at the Exhibition, would have been appreciably more notable than the very admirable demonstration which will, in fact, be given. The experience of the United States of America seems to show that no amount of elaborate buildings and costly apparatus can hasten the output of results except in so far as it discovers men of exceptional minds and provides them with the opportunity and means for work. There seems no reason to believe that any important piece of work has remained undone in the United Kingdom by reason of the imperfect sympathies of Government Departments, or that the sinews of war will fail of being provided when the corps of first-rate research workers grows to such an extent that a substantial addition to the funds now available becomes obviously needful.

Perhaps the most valuable agricultural feature of the Exhibition will be the possibility of comparing overseas methods and results in research and education with those obtaining here. As this article will be published before the Dominion and Colonial exhibits have been staged or catalogued, I can only make this point in general terms. It must necessarily be that many of the Dominion exhibits will be of general rather than intimate interest to us. South Africa will present an ostrich farm. The tropical countries will demonstrate the vast range of the raw materials produced by their agriculturists, materials which are the basis of no less vast manufacturing industries within the United Kingdom. Canada will show her almost unlimited possibilities as the granary of the Empire, but her arable problems are not ours. It is rather in the field of dairying and fruit growing that the parallel between home production and Dominion production will be most significant. In the New Zealand Pavilion will be seen a complete model dairy, which will be

purely a New Zealand demonstration in everything but the milk which will be used. It may be hoped that full information will be available not only as to farming and manufacturing methods but also as to packing and marketing. I am told that New Zealand has the happiness to employ both merchant methods and co-operative methods in collecting and disposing of dairy products, without that unhappy clash between the two sorts of interest which has made co-operation in this country an occasion for farming politics rather than an affair of plain business. It will be valuable, for example, to ascertain by association with New Zealanders whether, as is alleged in respect of Denmark, successful co-operation is the child of export trade only or is of equal value in respect of internal marketing.

The same general considerations apply to the growing, packing and marketing of fruit, about which there must be much to learn from the methods of Canada, Australia and South Africa.

The Exhibition indeed offers to the agriculturist and the horticulturist of the United Kingdom an unique opportunity of making a survey of Dominion and Colonial methods, whether in research or education, in cultivation or marketing, with a view to seeing how far the genius of daughter nations has evolved methods which are capable of being grafted on to United Kingdom practice with or without modification.

The Exhibition has provided, as part of the facilities for making the fullest use of this unique assemblage of Imperial products and Imperial men, a group of Conference Halls, and placed them at the disposal of responsible bodies who are concerned to discuss subjects, whether scientific, sociological or economic, which are of vital import to the closer organisation of the Empire and the development of its amazing heritage. Conferences of representatives from all parts of the Empire and of all manner of interests, such as world-power (electric, hydraulic, etc.), mining and metallurgy, textiles, publicity, etc., will be held at Wembley from April to October. It is disappointing to find that no application has been made for these facilities in respect of any agricultural subject, save on co-operation and glasshouse products.

I hope it may yet be possible, when the Overseas agriculturists who are due to come have arrived in England and have become acquainted with us, that some round-table conferences may be held on subjects of common import and interest in the Wembley Conference Halls, if they are then available, but if not, then elsewhere.

This short article is not and does not pretend to be a catalogue

are to be seen at Wembley. A hand list would be dull reading and would mean little. It is at Wembley only that the significance of Imperial agriculture can be intimately savoured. The British Empire Exhibition is something more than a gigantic shop window full of such a variety of products as have never more been brought together by the peoples of a single Empire. It is a field of comparative education, and at once a nursery and a clearing house of ideas.

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SHORT-TERM LEYS AS AN AID TO ARABLE FARMING.

W. A. C. CARR, M.C., N.D.A.,
Vice-Principal, Cheshire School of Agriculture.

SHORT-TERM leys have been severely criticised by adherents of arable farming, yet the writer ventures to suggest that temporary pasture is the key to profitable corn growing in some northern counties, and there seems no reason why the system should not be extended to other areas where the present depression is acute.

The writer has farming interests, and experience of leys, in Kincardineshire, and the manner in which short-term leys affect the arable crops in the rotation on farms in that county may be of interest. The soil is mostly drift, lying on the Old Red Sandstone; and stiff boulder clay, gravel, and sand, are often found in the same field. On the whole the soil is poor, but where it is composed of the underlying rock it is fairly good. Immediately to the south, the soils improve, and the four-course arable rotation becomes general. On one farm previous to 1912, a five-course rotation, containing a ley of two years' duration, was practised, though on occasion some of the heavy land was ploughed up after the first year's hay crop, and as a result carried an extra cereal crop. Even on the best land, corn crops following one-year's seeds were almost without exception poorer than crops after two-years' seeds, and the second cereal crop was usually more or less a failure. Not only was the crop poor but the land tended to become foul through growth of weeds. The seeds mixture used until 1911 contained large quantities of Italian and perennial rye grasses, which yielded poor crops of hay and still poorer pasture. This type of ley was really unproductive, though the succeeding crop derived considerable benefit.

When a student at the North of Scotland College of Agriculture, the writer was advised to try another seeds mixture, and this gave astonishing results. Red clover had always failed, absence of lime being erroneously considered the cause, but, without an application of lime, the improved seeds mixture provided abundance of red clover in the hay, and valuable pasture in the second year. The introduction of wild white clover made possible an extension of the ley, which had become profitable, and before the war it was arranged to extend the rotation so that a three-years' ley could be included. The war, however, changed the outlook, and all available land on the farm was under corn, before the inception of the War Cultivation Committee. Good corn crops were harvested during the rotation following the temporary leys, but, when the demand for corn prevented the formation of a ley, the falling off in yield of the arable crops was marked. Nevertheless, although crops were reduced some twenty-five per cent., corn growing remained profitable until prices slumped.

Six-Course Rotation with Three-Years' Ley.—During 1920, before the slump in prices, it was resolved to lay out the land on a six-course rotation, including a three-years' ley, and to effect this it was found necessary to work several fields without the intervention of a ley. Crops grown after corn crops, or one year's seeds, compared with crops following a two-years' ley, continued to demonstrate the value of the ley on every farm. The first field following a three-years' ley was harvested in 1923, and although conditions during springtime were amongst the worst on record, the crop of oats thrashed out at the rate of nine quarters per acré, this being two quarters over the previous highest record of the field, which is one of the poorest on the farm. The variety was "Victory," which had been grown on the field on previous occasions. A six-course rotation is now established, viz. :—

1. Potatoes, turnips and swedes, silage.
2. Barley or oats.
3. Seeds hay.
4. Pasture.
5. Pasture.
6. Oats.

The benefit conferred by the temporary ley does not end with the oat crop, as an increase is evident in every crop in the rotation. Potatoes, in particular, revel in the organic matter available after a good ley and in a cold, wet summer, a bit of good turf in the soil is exceedingly valuable. Such diseases as club root and

are to be seen at Wembley. A hand list would be dull reading and would mean little. It is at Wembley only that the significance of Imperial agriculture can be intimately savoured. The British Empire Exhibition is something more than a gigantic shop window full of such a variety of products as have never more been brought together by the peoples of a single Empire. It is a field of comparative education, and at once a nursery and a clearing house of ideas.

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SHORT-TERM leys have been severely criticised by adherents of arable farming, yet the writer ventures to suggest that temporary pasture is the key to profitable corn growing in some northern counties, and there seems no reason why the system should not be extended to other areas where the present depression is acute.

The writer has farming interests, and experience of leys, in Kincardineshire, and the manner in which short-term leys affect the arable crops in the rotation on farms in that county may be of interest. The soil is mostly drift, lying on the Old Red Sandstone; and stiff boulder clay, gravel, and sand, are often found in the same field. On the whole the soil is poor, but where it is composed of the underlying rock it is fairly good. Immediately to the south, the soils improve, and the four-course arable rotation becomes general. On one farm previous to 1912, a five-course rotation, containing a ley of two years' duration, was practised, though on occasion some of the heavy land was ploughed up after the first year's hay crop, and as a result carried an extra cereal crop. Even on the best land, corn crops following one-year's seeds were almost without exception poorer than crops after two-years' seeds, and the second cereal crop was usually more or less a failure. Not only was the crop poor but the land tended to become foul through growth of weeds. The seeds mixture used until 1911 contained large quantities of Italian and perennial rye grasses, which yielded poor crops of hay and still poorer pasture. This type of ley was really unproductive, though the succeeding crop derived considerable benefit.

When a student at the North of Scotland College of Agriculture, the writer was advised to try another seeds mixture, and this gave astonishing results. Red clover had always failed, absence of lime being erroneously considered the cause, but, without an application of lime, the improved seeds mixture provided abundance of red clover in the hay, and valuable pasture in the second year. The introduction of wild white clover made possible an extension of the ley, which had become profitable, and before the war it was arranged to extend the rotation so that a three-years' ley could be included. The war, however, changed the outlook, and all available land on the farm was under corn, before the inception of the War Cultivation Committee. Good corn crops were harvested during the rotation following the temporary leys, but, when the demand for corn prevented the formation of a ley, the falling off in yield of the arable crops was marked. Nevertheless, although crops were reduced some twenty-five per cent., corn growing remained profitable until prices slumped.

Six-Course Rotation with Three-Years' Ley.—During 1920, before the slump in prices, it was resolved to lay out the land on a six-course rotation, including a three-years' ley, and to effect this it was found necessary to work several fields without the intervention of a ley. Crops grown after corn crops, or one year's seeds, compared with crops following a two-years' ley, continued to demonstrate the value of the ley on every farm. The first field following a three-years' ley was harvested in 1923, and although conditions during springtime were amongst the worst on record, the crop of oats thrashed out at the rate of nine quarters per acre, this being two quarters over the previous highest record of the field, which is one of the poorest on the farm. The variety was "Victory," which had been grown on the field on previous occasions. A six-course rotation is now established, viz. :—

1. Potatoes, turnips and swedes, silage.
2. Barley or oats.
3. Seeds hay.
4. Pasture.
5. Pasture.
6. Oats.

The benefit conferred by the temporary ley does not end with the oat crop, as an increase is evident in every crop in the rotation. Potatoes, in particular, revel in the organic matter available after a good ley and in a cold, wet summer, a bit of good turf in the soil is exceedingly valuable. Such diseases as club root and

clover sickness are less prevalent, and many of the troublesome weeds of arable land disappear when pasture forms part of the rotation. Crops may also have a higher feeding value, as according to Collins,* oat straw is usually richer in albuminoids when the crop follows a ley. By extending the four-course rotation to a five- or six-course rotation, through the inclusion of a two- or three-years' ley, the area under roots will occupy one-fifth or one-sixth instead of one-fourth of the farm. Similarly the corn area will be reduced from one-half to two-fifths or one-third. The output of corn from a farm will certainly fall, until the effect of the ley causes an increase in yield, although with a more liberal use of manures it is quite possible to maintain the output on many farms. In fact the whole system tends to be more intensive, as good farmers resent a reduced corn output.

Farmers cannot but agree that leys confer a benefit on other crops, but some may consider the ley itself a doubtful source of profit. If, however, resort to pasture is a panacea for low corn prices, it is difficult to imagine why the ley in the rotation should not be as profitable as corn, unless the ley is so unproductive that it is less valuable than the average permanent grassland in the country. In the north of Scotland, temporary leys, when properly laid down, are more productive than permanent pasture. Such leys have been, and often still are, unproductive, but this is due usually to lack of knowledge or mismanagement, and the writer admits that for ten years he attempted, but failed, to establish a suitable ley. Hay crops were light and it was rare to find an appreciable quantity of red clover. Three acres of pasture were necessary to graze two bullocks, and fattening on a second year's pasture was never attempted. Since 1911, however, seeds have invariably yielded good crops of hay containing abundance of red clover, and when wild white clover is sown, the third year of the ley promises to be more productive than the first or second. Cattle now fatten readily on the pastures, and three acres usually provide abundant food for four animals weighing from eight to ten cwt. each. This would seem a rather better stock-carrying capacity than that attributed to leys in general.

Use of the Ley.—Cattle, when turned out to pasture for feeding, receive a small ration of cotton cake and seldom fail to make a satisfactory live weight increase whilst fattening. The pastures are mostly stocked with feeding cattle which are

* Journal of Agricultural Science, Vol. XII, Part 3.

sold fat in July and August. Lean stores—home bred, Irish or Canadian—are purchased in autumn, and these make good progress on the grass before being tied up for winter feeding. These stores are mostly fattened off during winter, but some of the younger growing animals are carried over, and may go off the grass fat by the end of the following June. It is arranged, as far as possible, to purchase stores when prices are moderate, which is usually during autumn, or February and March. The demand for grazing cattle in April usually exceeds the supply, and it is difficult to make a profit if one purchases at this time. A careful study of markets over a number of years will show that to obtain the best returns from feeding cattle, it is necessary to combine summer and winter feeding, and in order to effect this, either the ley or permanent pasture is necessary.

Leys need not necessarily be devoted to fattening cattle, as in many cases they are used for milk production or for the rearing of stock. The success of Aberdeenshire breeders testifies to the suitability of the ley for the latter purpose.

Seeding and Treatment.—The success of the ley depends largely on the composition of the seeds mixture. Large quantities of rye grass, especially Italian, smother the clovers and slower-maturing grasses. Indeed, the second- and third-years' pasture may be ruined if the total quantity of rye grass exceeds ½ bush. per acre. In the north, experiments usually show a reduction of the hay crop when Italian rye grass is included in the mixture. Cocksfoot is very productive in the second and third years, when given a chance. Experiments at Craibstone have shown that a fairly thick seeding of this grass is necessary if a tufty pasture is to be avoided. Late-flowering red clover, such as that produced in Montgomeryshire, should find a place in the mixture, for, when properly managed, it persists in the pasture for several years. Wild white clover is "worth its weight in gold" as a constituent of a seeds mixture, and to attempt to seed land down for a term of three years without a small quantity of this seed is a great mistake. In fact it should be included in every mixture intended for a two-years' ley. Half-a-pound of seed will cover the ground by the end of the second year where conditions are favourable, and the resultant green manure will benefit the succeeding crop to an extent which will more than pay the cost of the seed.

The seeds mixture recommended is that advocated by Findlay, Aberdeen, and is given in pounds per acre:—

12 lb.	Perennial Rye Grass.	1½ lb.	Late-Flowering Red Clover.
8 ,,	Cocksfoot.	1 ,,	Alsike Clover.
4 ,,	Timothy.	½ ,,	Wild White Clover (English).
2 ,,	English Red Clover.		

On light land the cocksfoot may be increased and the Timothy reduced, and on heavy land, if the tilth is rough, the seeding could be slightly increased. This mixture may not suit all soils and conditions, but it gives excellent results in the north of Scotland and in Cheshire. It has also given wonderful results on extremely poor acid soil in a smoky industrial area near Manchester.*

If hay and pasture is to occupy two or three years of the rotation, then the ley becomes the most important crop in the rotation, and success will not be obtained unless the farmer realises this fact. In general practice the seeds are too often considered of second importance to the nurse crop, whereas if the seeds are to remain down for some time, the nurse crop should, as far as possible, be selected and cultivated to suit the seeds. Heavy clay land must be ploughed early if it is to be seeded down, and it may be necessary to arrange the previous cropping so that the heavy land is cleared in time to be ploughed in the autumn. Where seeds are sown in spring corn, attention to this point may prevent frequent failures, for heavy land ploughed in spring seldom forms a fine seed bed. Wheat, barley and oats make suitable nurse crops, provided they are not forced by excess of nitrogen, or grown on too rich soil. In Cheshire seeds usually "take" better in oats than wheat, and the reason may be that the wheat is often too far advanced when the seeds are sown.

Seeds require a fine but firm seed bed and a light, but thorough, covering of soil, and it is usually advisable to sow at a time when there is sufficient moisture to germinate the seed. A dressing of basic slag or mineral phosphate, together with potash where required, should be harrowed in with the seeds, and if the previous crop has had a dressing of farmyard manure no further treatment should be necessary. If, however, the land is in poor "heart" a dressing of a complete manure containing nitrogen may be applied with advantage. Lime may be applied to the previous crop or at the time of seeding, if an application

* Second Report on Experiments at Taylor Fold Farm, Matley, Hyde, Cheshire County Council.

is considered necessary. On very light soils in dry areas it may be difficult to obtain a good "take" in years of low rainfall, but as the ley would be particularly useful under such conditions, it would be worth a special effort to establish.

Undoubtedly there are farmers who have already tried the ley in the rotation and found it wanting. One must certainly be careful in advocating a system which is not practised in a district, as farmers generally, by experience, find out the rotation which is most suitable for soil and climate. Temporary pasture has generally been found useful in Scotland if the fertile arable soils of Forfarshire and the Lothians be excepted, and it also finds a place in the northern counties of England. Further south one sees little temporary pasture, though in some parts the ley is now entering into the rotation. Even if one assumes that this distribution was economically sound twenty years ago, it may be otherwise to-day, for the approved ley of the nineteenth century cannot compare with that of to-day. The arable farmer expects the ley to accumulate organic matter, and the old-time ley usually failed because it became open in its second or third year. The introduction of wild white clover and a preference for perennial grasses, make possible the ploughing-in of a ley which adds a large amount of first-class manure to the soil at a minimum of cost. In addition, the roots of grasses and clovers improve the physical condition of the soil, whether it be heavy or light; other crops grown for green manure cannot compare with the ley in this respect.

In some areas lucerne or sainfoin might form the ley, and where soil and climate are suitable the cultivation of these valuable crops might be extended.

Adaptability of the System.—The arable area is undoubtedly a national asset, but land is being rapidly laid down to permanent grass. Surely the ley is preferable, if by its use the plough land can be maintained. In the event of war, temporary pasture lends itself to conversion into corn land more readily than permanent grass. Farmers will quickly plough up their leys when corn prices justify the change, whereas it takes more than a rise in the price of corn to bring permanent pasture under the plough. Moreover, crops following short-term leys will yield better than crops grown after old grass land, as wireworms often ruin the latter.

Arable farmers have no need for leys when the price of cereals is high, because lower yields are remunerative. Good soils may continue to yield corn crops which allow a small

margin of profit at present prices, but the increased cost of cultivation is a heavier burden on poor land, and unless the crop is fairly good it cannot pay. In England and Wales the average yield of wheat, barley and oats from 1912-1921 is given as 30.7, 30.8, and 38.3 bushels per acre respectively. Even on low-rented land it does not seem possible that the cost of production could be so low as to leave a profit to the farmer, unless the yield is above these figures. The cost of production is substantially the same for good and for poor crops, and average crops are therefore unlikely to be grown at a profit. Even on poor land the introduction of a temporary ley will increase the yield, without additional manure, and this increase should allow a small margin of profit. In the absence of experimental evidence, it is, however, impossible to estimate with any degree of accuracy the increase in crops attributable to the ley.

The adoption of the ley may present some difficulties. If fields are to be grazed, they must be fenced, and it is almost necessary to have water in every field. Increased capital is also required to stock the pastures, and the cash returns, until the rotation is established, tend to be reduced. These difficulties can be overcome to some extent by mowing the leys, but the price of hay in arable districts is often low and the returns could hardly compare with grazing.

The system can of course be tested in any arable area by seeding down a single field on the lines indicated. It is, however, useless to leave a field seeded with Italian rye grass for an extra year, as this does not constitute the type of ley advocated in this article.

The writer does not claim that the ley will solve all the problems of the arable farmer, but temporary pasture certainly helps some farmers to carry on, and it seems reasonable to think that it would assist others.

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WHEAT POOLS IN AUSTRALIA.

THE system of selling wheat through State-controlled pools was initiated in Australia in respect of the 1915-16 crop, in consequence of the abnormal conditions of the trade resulting from the war. The scheme was entered into by the Governments of the Commonwealth, and the States of New South Wales, Victoria, South Australia, and Western Australia, for the purpose of realising to the best advantage the wheat har-

vests of the respective States, and for making advances to farmers pending the realisation. Subsequently, it was decided that the 1916-17 harvest, and later the 1917-18, 1918-19, 1919-20, and 1920-21 harvests should be dealt with on similar lines. The general outline of this scheme is stated in the official Year Book of the Commonwealth of Australia, to be as follows:—

1. All growers were to participate equitably in the realisation of the harvest and the proceeds thereof.

2. The limited freights available for export of corn were to be allotted between the States, in accordance with the exportable surplus of each.

The securing and general allotment of freight was under the control of chartering agents who were responsible to the Commonwealth Government.

The duty of realising the crop was placed in the hands of the Australian Wheat Board, consisting of ministerial representatives of the Governments of the Commonwealth and the respective States, and one representative of the growers from each State. The Board was assisted by an Advisory Board, consisting of well-known wheat shippers, and the distribution of freights amongst the respective States was undertaken by the Wheat Board. As the United Kingdom was the chief export market for Australian wheat, and London the chief port, a London Wheat Committee, consisting of the High Commissioner, and the Agents-General of the States concerned, acting with the advice of the London representatives of the wheat shippers, arranged the overseas sales.

The Australian Wheat Board fixed all prices at which wheat might be sold, except in the case of poultry-feed, which was left to the individual States to regulate at their own discretion. Each State has a local Board or Commission to control the operations of the Scheme within its area, and the local Board effected all local sales, including sales to millers. Agents of the State Governments were appointed to receive wheat on behalf of their respective Boards, and these agents were usually merchants, millers, or other authorised persons, having facilities for receiving, storing and shipping wheat, and were required to furnish adequate bond. On receipt of the wheat, the Government agent issued a storage certificate showing the quality and quantity of wheat delivered. On shipment of the wheat, the agent handed the shipping documents to the Minister, for transmission to the London Board or other overseas agents.

Under arrangements with the Australian banks made by the Commonwealth and State Governments, advances were made to farmers upon delivery of their wheat at railway stations to the appointed representatives.

The proceeds of wheat sales were applied, as realised, in in reduction of the bank overdrafts which had been used for payment of advances and expenses. The rate of interest payable to the banks was 5 per cent. in respect of each of the crops up to 1919-20, and 6 per cent. for the 1920-21 harvest. The Government of each State had undertaken to repay all advances made on account of the State, and the Commonwealth Government had guaranteed repayment by the States.

With regard to the advance made to growers, this varied from year to year.* The advance in New South Wales, for example, was 4s. 10d. per bushel in respect of the 1915-16 crop, 3s. 3d. for 1916-17, 4s. for 1917-18, 4s. 10d. for 1918-19, 7s. 6d. for 1919-20, and 6s. 3d. for 1920-21. The advances are made by means of certificates issued by the appointed agents, payable at banks named by the growers.

In all the States, certain wheat, particularly seed wheat, was not brought under the Scheme. The quantity of wheat pooled consequently differed from that harvested in each State. The pools were not, however, solely restricted to wheat grown in the particular State, but wheat grown in one State was permitted to be sold through the pool of another. A considerable quantity of New South Wales wheat was, in this way, disposed of through the Victoria Pool. The wheat pooled in each State for the 1920-21 crop (up to 1st August, 1921) is indicated in the following figures:—

New South Wales ...	50,982,000	bushels.
Victoria	38,563,000	,,
South Australia ...	31,833,000	,,
Western Australia ...	10,475,000	,,
Total	131,853,000	,,

The original scheme, which underwent certain modification in respect of harvests subsequent to 1916-17, came to an end with that of 1920-21. In 1922 the compulsory pooling of wheat was abandoned, but the principle of pooling the exportable surplus was continued on a voluntary basis under the respective State Governments acting independently of each other. Under this scheme, as in the case of the compulsory scheme, each State

ultimately receives, in respect of the grain actually shipped, the average net profit from the overseas realisations which, after paying expenses, is distributed *pro rata* amongst the growers.

Under the latter scheme the organisation for marketing the exportable wheat is roughly as follows :—

There are three wheat pools : (*a*) Victoria, (*b*) South Australia and New Zealand in conjunction, (*c*) Western Australia. Growers are free to dispose of their produce to the State pool of their own Government, or to that of another State Government, or not, as they choose. In respect of each pool there is established a Wheat Board, analogous to the Australian Wheat Board referred to above, which is responsible for the purchase, collection, storage, financing, shipping and marketing of the grain. Under the Wheat Board an agent is appointed to purchase wheat from the growers, making, on behalf of the Board, an advance for the wheat received of about 3s. per bushel. The agent receives the grain from the grower, usually in bags at the local railway station, and ships it to the port. These agents, who are mainly drawn from the principal firms engaged in the grain trade prior to the starting of the pooling system, are under State control, and are allocated certain districts from which they are authorised to collect wheat under the scheme.

This system of pooling still remains in operation, and the grain exported to the United Kingdom is distributed in this country through the "Australian Wheat Pools Agency," consisting of three firms, which receive and market the whole of the wheat exported by the respective Wheat Boards, operating upon the British corn exchanges, mostly in London.

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THE DEVELOPMENT OF AGRICULTURAL COSTINGS IN DENMARK.

The Work of the Danish Bureau of Farm Management.*

For some years past an interesting experiment in agricultural costings has been proceeding in Denmark and the results are of considerable interest to agricultural economists outside that country. Indeed, the work that is being carried on by Professor

* Undersøgelser over Landbrugets Driftsforhold, VI, *and* Meddelelser fra Det landøkonomiske Driftsbureau, 6. Meddelelse, 10, December, 1923, *issued by* Det landøkonomiske Driftsbureau.

Larsen at the Danish Bureau of Farm Management has already ceased to be entirely experimental and is rapidly taking a definite place in the machinery of agricultural administration and intelligence in Denmark.

The History of the Experiment.—The definite movement towards the adoption of modern methods of book-keeping among Danish farmers, and the introduction of a system of agricultural costings, may be traced back to the efforts made as early as 1890 by some of the local agricultural societies to encourage farmers to keep proper accounts by making an approved system of book-keeping one of the conditions with which farmers had to comply who entered for the competitions organised by these societies. Some of the societies, too, helped on the movement by preparing for their members model forms of account specially adapted for particular types of farming. The Co-operative Agricultural Association in Zealand, for example, distinguished itself by the work it undertook in the years 1904-1910 to determine the best method of book-keeping for those farmers who were desirous of adopting a costings system applicable to farm crops. The practice spread of making farming accounts an essential feature in the competitions organised by the leading agricultural associations, and the work of propaganda was largely aided by the agricultural schools and institutes which gave farm accounting a leading place in their curricula.

It was gradually found, however, that something was wanting in the system of agricultural account keeping in Denmark, and that what was missing was a method of organisation. How this organisation or directive influence was to be supplied was a question to which it was not easy to provide an answer, and consequently, in 1910 the Royal Danish Agricultural Society set up a Committee to investigate the matter. This Committee was specially authorised to draw up rules for the keeping of accounts applicable to both large and small farms, and, further, to make recommendations as to the best way of placing the organisation of agricultural accounts in the country on a basis which would be both stable and adaptable to modern requirements. In 1913 the Committee produced a report, and shortly afterwards account-books drawn up by it were published and were widely circulated.

The most important result of the deliberations of this Committee was, however, the birth of the idea of a central bureau to deal with agricultural accounts. This project became a topic of general discussion in interested circles, and at a meeting of the Royal Danish Agricultural Society held in November, 1915,

it was resolved that a plan for the establishment of such a bureau should be worked out in consultation with all organisations that were concerned with the proposal. In May, 1916, a special sub-committee of the Society was appointed to prepare a detailed scheme of working, and in January, 1917, the proposals made by this committee were accepted by the Society. Pending the establishment of the Bureau, the special sub-committee of the Society proceeded with the collection of material for the use of the Bureau, and commenced the analysis of accounts on the lines that it was proposed should be adopted by the Bureau. In the spring of 1918 the Bureau was definitely set up as an independent organisation, and at once proceeded to function. An annual subsidy of 12,000 kr. was granted by the State; this subsidy was increased in 1919-20 to 15,000 kr., and for the current year the subsidy will amount to 50,000 kr.

Organisation of the Bureau.—The Bureau is managed by a Committee, on which serve representatives of the Central Danish Agricultural Co-operative Association, the Royal Danish Agricultural Society, the Co-operative Association of Danish Smallholders, the Statistical Department of the Danish Government, and similar bodies. The Director is Professor O. H. Larsen, who is also a member of the Committee, and he is aided by a Deputy-Director and seven or eight assistants. The offices of the Bureau are situated in Copenhagen. Apart from the State subsidy already referred to, the Bureau obtains some revenue from the sale of account-forms and by directly managing the books of certain estates and large farms. Payment is made by the Bureau to the local societies for each completed account sent in at the rate of 10-15 kr. for each account.

Method of Obtaining Accounts.—The method adopted of obtaining accounts for the Bureau is by means of a system of local societies which, in connection with farm institutes and agricultural associations, have been set up by farmers expressly for the purpose of providing assistance in the keeping of accounts and of rendering it possible for individual farmers to obtain the help and advice of an expert agricultural accountant. Of these societies there were approximately 60 in existence in 1923. It is the usual practice for the accounting societies to appoint an accounting officer, whose duty it is to assist the members of the society to keep proper accounts and to examine the progress made by them from time to time. At the end of the financial year the accountant conducts an audit, and places himself in a position to be able to certify that the completed accounts are

accurate in all particulars. Some of the accounting officers employed by the societies find it possible to keep going about 30 separate farmers' accounts. In normal circumstances the accountant makes a personal visit to each farm, the accounts of which are under his charge, once or twice a month. Financial assistance is afforded by the State to those societies that are prepared to comply with certain conditions, which require that the system of accounting adopted should be an approved one, that the accounts kept are not restricted to particular branches of farming, and that the results obtained shall be available for publication if required.

The Central Bureau and the Local Societies.—The Bureau of Farm Management keeps in close touch with the local societies by means of the expert accountants, who are able at all times to communicate with the Bureau on points of difficulty that arise, and who attend annually a three days' conference, at which the work of the preceding year is discussed, improved methods of agricultural costings are considered, and the lines of the forthcoming year's activities are laid down. The Bureau also undertakes the direct supervision of the accounts kept on certain estates and larger farms, and in this way is enabled to keep in close touch with the actual details of some part of the accounting work that it organises and directs. Only a proportion of the separate accounts that are kept by the farmers who are members of the local societies are used by the Central Bureau in their annual economic analysis of the position of Danish agriculture. In 1922-23, for example, the total number of accounts which were kept in association with the 60 existing local societies was approximately 2,500, of which it may be expected that between 500 and 600 will be included in the final costings analysis issued by the Bureau.

The Publications of the Bureau.—Although the Bureau has only been in existence for a few years, it has already earned a well-deserved reputation for the excellence of its publications. The Sixth Report of the Bureau, which includes the results of the investigations for the year 1921-22, is a noteworthy contribution to the literature dealing with the economics of the farm. In the 190 pages of the Report, the 500 accounts analysed have been considered from every possible point of view; such questions as the amount of capital employed on farms of various sizes, the comparative working expenses on farms in different parts of Denmark, the gross output per hectare on different sized farms, the gross and net profit earned on various sized holdings, and

the remuneration obtained by the small farmer who employs no labour other than his own family, all receive detailed examination. When it is realised that the Report includes no fewer than 76 summary tables, of which many give comparative figures for a series of years, in addition to special tables furnishing information for each of the 500 accounts included in the analysis, it will be seen that Professor Larsen has spared no pains to place all the information so laboriously collected at the service of agricultural economists.

The Chief Results of the Investigations.—It is, as a general rule, the prosperous farmer who is willing to keep and furnish accounts, and should results become less favourable a farmer who has in past years been a member of a local accounting society frequently resigns from the society. This has an unfortunate result on the continuity of the material with which the Central Bureau has to work, and, indeed, it is rare to find that a farmer who furnished accounts in 1917-18 is also furnishing accounts in 1921-22 or 1922-23. In view of this fact, the results that may be deduced from the information which the Central Bureau has made available are likely to appear as rather more favourable than is really the case, and the accounts which are shown may be regarded as being applicable to farmers who are in a superior class, both as regards scientific knowledge and business aptitude.

After having been winnowed by the Central Bureau, the number of accounts actually included in the tables printed in the reports for 1921-22 was 500. This number shows a considerable increase on that for the previous years, as will be seen from the following table, which shows the number of holdings of each size in each area for which the accounts were examined by the Bureau :—

	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.
Under 10 ha.*	14	24	35	47	40
10-20 „	42	51	67	90	89
20-30 „	68	78	83	111	120
30-50 „	70	95	108	121	143
50-100 „	29	38	49	60	67
Over 100 „	12	19	29	37	41
TOTAL ...	235	305	371	466	500

* 10 hectares = approximately 25 acres.

The following table gives the results of the examination of the 500 accounts for the year 1921, in respect of the various sized holdings :—

KRONER PER HECTARE.

	Capital employed.	*Gross Yield.*	*Cost of production (Outgoings).*	*Net Yield.*	*Net percentage returned on capital.*
Under 10 ha.	3,488	1,247	1,246	1	0
10-20 "	2,896	867	849	18	0.6
20-30 "	2,874	876	825	51	1.8
30-50 "	2.749	784	746	38	1.4
50-100 "	2,485	651	630	21	0.9
Over 100 "	2,494	677	632	45	1.8

Similar figures are available for each year since 1917-18, and these figures have been summarised into one group of holdings showing in £ per acre the capital invested, the gross yield, the outgoings, the net yield and the percentage return on the capital invested :—

£1 PER ACRE, CALCULATED AT PAR.

	Capital Invested. £ s.	*Gross Yield.* £ s.	*Out-goings.* £ s.	*Net Yield.* £ s.	*Percentage return on capital invested.*
1917-18 ...	62 18	15 12	10 15	4 17	7.7
1918-19 ...	64 2	19 2	12 6	6 16	10.6
1919-20 ...	63 10	22 16	16 11	6 5	9.9
1920-21 ...	64 8	26 8	21 3	5 5	8.2
1921-22 ...	62 12	18 11	17 16	0 15	1.2

From this table it will be seen that Danish agriculture has had very varied prosperity over the period of years in question, and that in 1921-22 the position of the Danish farmer was a very serious one. In 1918-19, on the other hand, the return that he received for his work was very substantial.

In looking at the above table it has to be borne in mind that the capital invested includes the capital value of the land, buildings, equipment and stock of all kinds.

When examined in detail it becomes evident that the most important result from the farmer's point of view, of his operations in 1921-22, was the drop in gross output per hectare as compared with the year 1920-21. On the average the gross output showed a decline from 1,185 kr. per hectare in 1920-21 to 831 kr. per hectare in 1921-22, or a reduction of 30 per cent. This result is largely due to the pronounced fall in the prices of agricultural products during the latter half of the financial year 1921-22; another contributing factor in some parts of the

country was a comparative failure in certain crops. To counterbalance to some extent the drop in gross yield between 1920-21 and 1921-22, there was a drop in working costs of 151 kr. per hectare. This reduction is due partly to a decrease in wages paid to labour and partly to a fall in the price of feeding stuffs and other commodities.

The net yield to the farmers in 1921-22 was very poor indeed. The detailed figures published by the Bureau make it clear that in the case of the small holdings, there was no net yield at all. Apart from this class of holding, however, there was no essential difference between the yield obtained on medium-sized holdings and on large farms.

The Bureau has recently issued a preliminary statement covering the analysis of about 200 accounts for the year 1922-23. These show that the net yield per hectare has risen from the low average figure of 33 kr. in 1921-22 to 140 kr. in 1922-23, while the average percentage return on capital invested has risen from 1.2 to 5.4. These figures would appear to indicate that agriculture in Denmark is on the road to recovery after the decline in 1921-22.

It is in arriving at general conclusions on the way in which small, medium and large holdings are affected by varying economic conditions, that the work of the Bureau is of such great value to the agricultural economist at present. When to the series of figures at present available, further years have been added, the value of the results obtained by the Bureau will increase to an extent that can only be realised by those who have searched for, and failed to find, reliable costs data for agriculture extending over a reasonable period of years.

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HOARY PEPPERWORT: A WEED MENACE IN THE S.E. COUNTIES.

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Ministry of Agriculture and Fisheries.

With Drawings from Nature by BERTHA REID.

HOARY Pepperwort (*Lepidium Draba*, L.), a perennial weed of the mustard and charlock order, and variously known in Essex and Kent as chalk weed, Thanet weed, hoary cress, whitlow pepperwort, white weed, and devil's cabbage, has in recent years become a most disturbing factor in Essex and Kentish farming. It is clear that this obnoxious weed is spreading in

these two counties, and it is certainly desirable that every farmer should be made familiar with it. Those who have unfortunately come into practical contact with this weed regard it as a serious menace, for it has caused heavy losses, and is costly to tackle. Farmers in all counties, but in Essex and Kent particularly, would be well advised to keep their eyes open for its first appearance and then give it no chance to become established.

Distribution.—The distribution of this weed in England was discussed in April of last year at the School of Agriculture, Cambridge, at a meeting attended by a number of County Organisers and County Officials. Professor Biffen emphasised the dangerous menace to agriculture which the spread of this weed constitutes. Thirty years ago it was one of the rarest plants in East Anglia, but its presence as far north as Norfolk has now been notified. It has certainly been found as a weed of cultivated land in Essex for somewhere about 35 years, though it seems probable that it has only become widely troublesome in the last 15 years. Its virulence in Essex and Kent is well known. It has also (1923) been found in Buckinghamshire, at Wendover.

Hoary Pepperwort has travelled from the old world right across the United States to California, which it seems to have reached some 17 years or so ago, and is becoming one of the worst plant enemies of the sugar beet grower. The weed is also very prevalent in parts of New Zealand, and is widely spread throughout Victoria, where it is a proclaimed weed under the Victorian Thistle Act.

Hoary Pepperwort must be regarded as an "alien" in Britain, though it is a common weed on the Continent. According to a communication from Mr. E. E. Turner, well-known as an authority on the Essex flora, to Mr. R. Robson (East Anglian Institute of Agriculture, Chelmsford), the weed was introduced in 1809 by troops returning from the Walcheren.

Seed.—The seeds (Fig. 1, *a*) are about one-twelfth of an inch long (1.5 to 2 mm.); broadly egg-shaped, sometimes slightly tapered, may be slightly compressed; dark brown, brown to purplish; surface dull. According to Burchard* the seeds are found here and there in mid-European red clover seed. In the United States they occur in Lucerne samples.† During the

* O. Burchard, Die Unkrautsamen: Berlin, 1900.

† 22nd An. Rept., Agric. Exp. Sta., Univ. of Nebraska, 1909.

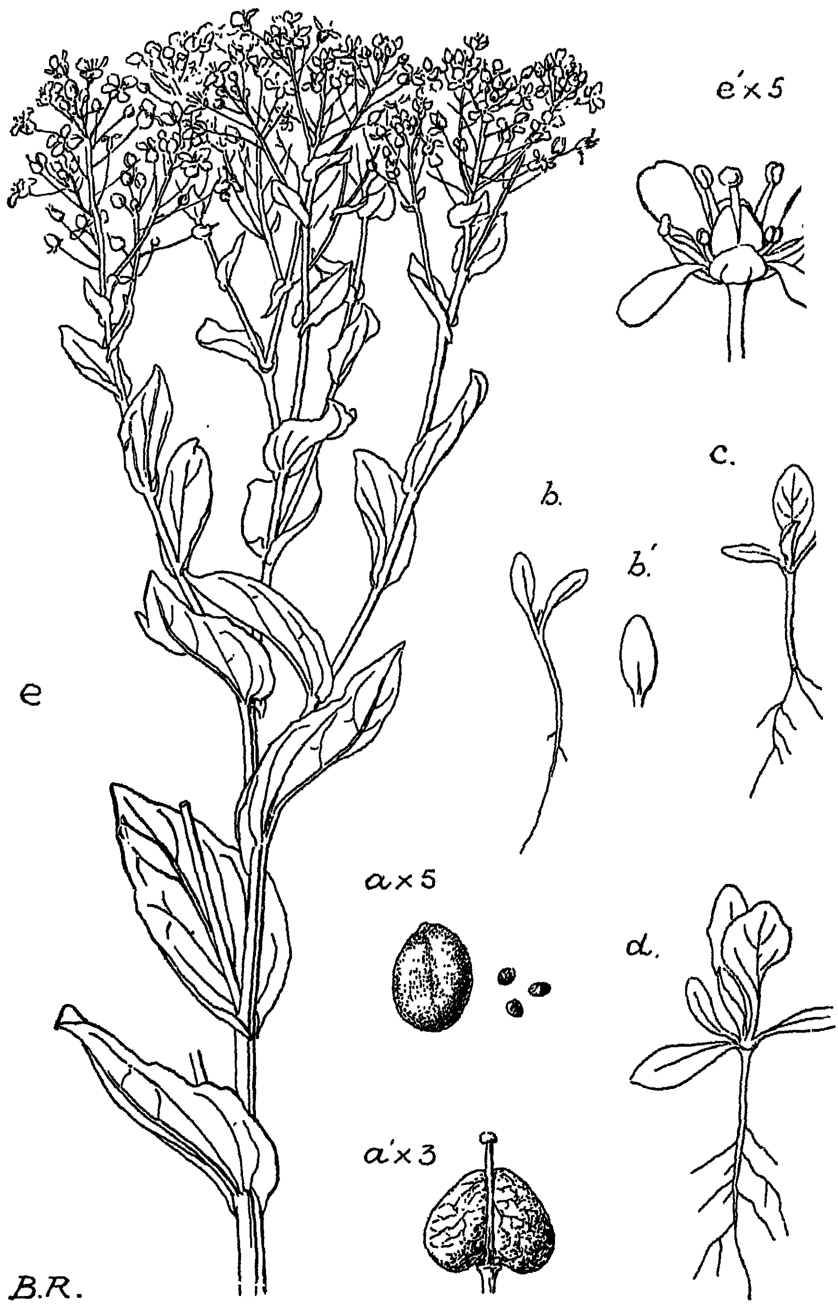

FIG. 1. —Hoary Pepperwort (*Lepidium Draba*, L.).

a. Seed, nat. size and ×5; *a′.* seed vessel ×3; *b.* early stage of seedling ×1; *b′.* cotyledon or seed-leaf; *c.* second stage of seedling ×1; *d.* third stage of seedling ×1; *e.* flowering plant ×1; *e′.* flower ×5.

ɟ. 2.—Hoary Pepperwort (*Lepidium Draba*, L.), showing variation in foliage of mature plants. (About nat. size).

past month they have been found, at the Official Seed Testing Station, in a sample of tall fescue.

Seedlings.—In the seed-leaf stage (Fig. 1, *b*) the root of the seedling is thread-like. The part immediately below the seed-leaves is whitish to green, stout and smooth. The cotyledons (seed-leaves) are oval, narrowing to a broad petiole (leaf-stalk), and light green above and below, fleshy, about one-third of an inch in total length and one-eight of an inch broad. The first true leaves (Fig. 1, *c*) are small, spring from the base, oval to nearly round, narrowing to a broad petiole, light green, smooth, and with a clearly marked midrib. In a rather later stage (Fig. 1, *d*) the leaves are oval to round-oval, smooth, with a long petiole channelled above, a clearly shown midrib, and some have a slightly irregular margin.

Mature Plant.—Hoary Pepperwort (Fig. 1) has thick cord-like roots, branched stem, and oblong to somewhat lanceolate leaves, the lower of which are shortly stalked and the upper with an arrow-headed base which clasps the stem. It is somewhat variable, however, many plants being much more branched than others, while in some cases the leaves have broken or irregularly toothed margins rather than the usual unbroken margin (Fig. 2).

The small white cruciform flowers are about one-fourth to one-eighth of an inch in diameter, borne on slender flower stalks in broad flat clusters, and the two-seeded pods are thick, nearly heart-shaped, and constricted in the centre. The plant is stout, covered with fine down (though this is variable), and one to three feet in height. It flowers in May and June, and may be spread rapidly by seed and steadily by the root-stocks. Robson says: "Above ground it is as bad as charlock, below ground it is as bad as bindweed." Its appearance when in flower in a corn crop is very striking (Fig. 3).

Soil and Situation.—It appears to invade most soils in Essex, light or heavy, and also most sites, as Robson states: "It can maintain its existence amongst grass and lucerne, and it grows luxuriantly in many ditches, and in waste heaps by the wayside. When the ground is cultivated for corn, etc., it grows vigorously." The long root stocks have been found in the deepest drains, and have been traced to a depth of four feet.

Eradication.—As regards combating the weed generally, the principles on which to proceed may be given as follows:—

1. *Regular* and *frequent* cutting to prevent seeding and exhaust the root-stocks;
2. Well-hoed root and other crops, and thorough tillage operations;
3. If absolutely necessary, a bare fallow with deep ploughings and cultivating;
4. A smother crop of mustard, vetches, or maize;
5. Spraying as indicated below.
6. Refuse in badly cleaned thrashing machines may distribute the seeds.
7. Seed of local origin should be examined both by vendor and purchaser to ensure that it is free from this weed.
8. The distribution of the weed in seeds hay, clover hay, etc., should be guarded against. The sale of such hay off the farm producing it might lead to serious results—and has probably already assisted in the distribution of the weed.
9. Let farmers co-operate to guarantee one another as far as possible against local distribution of this serious pest.

Experiments conducted by Robson* indicated that spraying the weed (both in the field and along hedgerows) about the beginning of May with 80 gal. per acre of a 4 per cent. solution of copper sulphate (= 32 lb. in 80 gal.); or (preferably perhaps) with 27½ lb. of nitrate of soda and 16½ lb. of copper sulphate in 110 gallons of water per acre, destroyed the weed above ground, and therefore prevented seed production, while the outer leaves only of the cereal crop were killed. In the case of the latter spray fluid the weed was killed to a considerable depth below the soil. It was considered likely that two annual sprayings would be found necessary. A horse-sprayer would be desirable as in the case of charlock.

Spraying trials were conducted in 1921 and 1922 in Kent,† and Garrad's general conclusions indicate that spraying when the plant is in full flower is most effective, destroying the leaves and flowers, preventing seeding, and preventing the smothering of the corn crop. Persistent spraying should gradually weaken the weed. The spray fluids suggested are 40 lb. of copper sulphate in 80 gallons of water; or 2 cwt. of sulphate of

* Control of the Weeds Whitlow Pepperwort and Black Mustard, R. Robson: this *Journal*, Vol. XXVI, Ap., 1919, p. 56.

† Hoary Pepperwort or Thanet Weed, G. H. Garrad; this *Journal*, Vol. XXX, May, 1923, p. 158.

Fig. 3.—Hoary Pepperwort in bloom, as the predominant plant in a corn crop.

ammonia in 60 gallons of water; or 14 lb. of copper sulphate and 56 lb. of sulphate of ammonia in 70 gallons of water.

After having one portion of a field hand-weeded for 18 years, Mr. John Steel, of Rochford, is stated to have kept the weed to its original area, but it still continued to grow!

It should be strongly emphasised that the roots penetrate deeply and widely, and the plants produce an abundance of seed, and exertions must be continuous if rapid multiplication is to be avoided.

Hoary Pepperwort has caused heavy losses in California, and the Californian experience is of interest. In the *Monthly Bulletin* of the Department of Agriculture for that State (Feb.-March, 1922) it is recorded: (1) that it suffers readily from drought, and "in a drought-weakened condition is killed easily by close cutting"; and (2) that "for the underground stems, thorough cultivation through an entire season will do much, and probably a second season of the same thorough work will finish the job in a given location." It is there found that in a crop like sugar beet, hand pulling is about the only measure practicable, care being taken to pull up as much as possible of the rootstocks. The Bulletin referred to pertly says: "Efforts to control this now recognised pest failed and all the outside aid obtained was the name and the information that it was a difficult plant to eradicate."

"It was soon realised that infestation by this plant made summer crops difficult, then unprofitable, and finally, in many cases impossible. Hay sold from infested fields spread the infestation and unclean grain added to its distribution." Some farmers sacrificed a whole season to cultivation, to bring the weed under control, and failed. "This result was so discouraging that a second season's cultivation was not attempted although this might have been successful in establishing control." It was introduced to California in lawn grass seeds, lucerne, flower seeds and beet seed, and by flood waters from other districts.

This weed was well known to Mr. Primrose McConnell in Essex many years ago, and he permits me to quote from a letter as follows:—"I never saw or heard of it till I came to this corner of Essex. A neighbour informs me he has dug down 4 to 5 ft. and the roots went deeper still. I have none on my farm as yet, but it is only some fields away. One farmer has sowed down some fields, as his arable crop was smothered with it and it was a hopeless case. Ordinary weeding and cultivation is of no use, and even fallowing fails to kill it: perhaps two years' successive fallow might settle it, but I am doubtful."

THE MANAGEMENT OF AN INSTITUTION FARM.

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AT the Surrey County Mental Hospital, Brookwood, the farming policy is essentially governed by the needs of the Institution. The purpose of the farm is to provide, as far as possible, all the milk, potatoes, pork, eggs, etc., required, and to utilise the waste material—always a large item where many people are housed and fed.

As it is fulfilling this purpose very efficiently and also very economically, the details of cropping, stocking and general management of this farm will no doubt be of special interest to those responsible for the management of similar farms.

The Institution usually accommodates from 1,200 to 1,400 patients in addition to a large residential staff.

The farm is managed by a sub-committee of four, acting through the steward of the Institution and the farm bailiff, who have kindly furnished the statistics for this article. Broadly speaking the farming policy is decided by this sub-committee, which meets regularly and periodically; at these meetings the schemes of cropping, manuring, marketing, etc., are brought forward and either approved or amended, the details of carrying these out being left to the steward and bailiff who report at each meeting.

The same committee is responsible for the 21 acres of gardens, which are supervised by the steward and the head gardener, and which supply the Institution with fruit and vegetables.

The Farm.—The area of the farm is 153¾ acres, of which 81¾ are arable and 72 grass. It is situated on the Bagshot Sands within two miles of Bisley and five of the village of Bagshot, to which this geological formation owes its name.

It is well known that, except in favoured parts in valleys where deeper soil has accumulated or where alluvium is present, the soils on this formation are very poor and a great part of the area consists of barren commons and army camps. The soil on the farm under review may be said to be fairly typical of the poor type which abounds in the north-west part of the county, and much of the land, if not highly farmed, would soon revert to something little better than waste land covered with heather. The soil is largely composed of coarse sand with pebbles, and, except in the lower parts, possesses a very small

water-holding capacity and cannot lift water from below in dry times. Its yielding power is therefore very much limited by the amount of rain falling at the right time of the year, and is increased by any amelioration of the soil which increases its water-retaining powers, *i.e.* the frequent application of organic matter in the form of dung, etc. Manures have no lasting effect on this type of soil, and, practically speaking, each crop must be manured individually and not be regarded as part of a rotation. The following will illustrate these points :—

In some grassland manuring trials on a dry part of the farm, the yields of hay from the unmanured plot taken each year in the middle of July have been as follows (the rainfall during the preceding months being given alongside) :—

	Yield per acre.		*Inches of rain, Feb.–June inclusive.*
	cwt.	*qr.*	
1921	7	3	... 3·78
1923	22	3	... 9·55

It might be mentioned here that on one of the poor fields in the dry season of 1921, a seeds mixture sown in the spring failed over the whole area with the exception of one strip of land down the centre of the field. Inquiry showed that in the previous winter the farmyard manure for the field beyond had all been carted down this ridge. We may assume therefore that the extra consolidation caused by this heavy carting improved the water lifting capacity of the soil and enabled the seeds to germinate and maintain their existence until the rains came in the autumn.

Grassland manurial trials have shown that applications of artificial fertilisers will increase the yield and improve the quality of the hay, but that their effect is not lasting. Experiments and analyses have shown that the soil has a low content of lime and is poor in all plant foods.

Stock.—*Cattle.*—A dairy herd of 33 cows is kept to supply milk for the Institution. The cows are Dairy Shorthorns with a few Ayrshires and Ayrshire crosses.

It has been the object in recent years to grade up the cows with a view to having a herd of heavy milkers, and for this purpose the yields are recorded by the Surrey Milk Recording Society under the Ministry of Agriculture's Scheme. Poor milkers are weeded out and the heifer calves from the best milkers only are retained to be brought into the herd later on. A pedigree Lincoln Red Shorthorn bull of good origin is being used. In the milk recording year ended 1st October, 1922, the herd average as authenticated and checked by the Ministry of

Agriculture was 7,308 lb., or approximately 717 gallons. This can be considered a very useful average for a herd of this size.

Every effort is made to produce clean milk: the cowshed is good, with water laid on, and a modern clean-milk pail is in use.

The young stock comprise 25 heifers and five weaning calves. All these are home reared and thirteen of the heifers are in calf.

Pigs.—The keeping of pigs is an important branch of the farming at this Institution. Approximately the same number of sows is always kept. The following figures show the stock in 1922 and 1923:—

	31st March, 1922.	*31st March, 1923.*
Boars	2	2
Sows	35	37
Suckers	130	94
* Others	241	226

* With the exception of a few selected gilts these are being fattened for pork or bacon.

The boars are of the pedigree Middle White breed. The sows are largely home bred, and as pedigree boars have now been used for many generations are of a very useful Middle White type. It has now been decided to work up a pedigree herd and five of the sows are pedigree Middle Whites of well-known strains.

Each sow is expected to have two litters in the year, and as far as possible it is endeavoured to arrange for the farrowings to take place from December to February and June to August. Suckers are weaned at eight weeks, and pigs suitable for breeding purposes are selected from them.

Each week two pigs of an average dead weight of 18-19 stone are required by the Institution. Other pigs are sold fat in the market at 14 or 15 stone dead weight at the age of five or six months. Some gilts are sold for breeding purposes.

During the year ended 31st March, 1923, the following were sold or slaughtered for the Institution:—

Sold fat in the market and to butchers	409
Slaughtered for the Institution	91
Sold in market...	4 sows
Sold for breeding	34 gilts

With the exception of a few pedigree gilts purchased for breeding purposes, no pigs were bought during the year.

Horses.—Eight horses are kept, but two of these are wholly employed carting coal, etc., for the establishment.

Poultry.—About 200 hens and 50 laying ducks are kept, the former comprising White Wyandottes, Light Sussex, Rhode

Island Reds and White Leghorns. All the eggs produced are required by the Institution.

Labour.—The main work on the farm is done by regular hands, vicarious help being given by patients. The work of the latter is not very reliable and has to be organised in gangs and supervised by reliable men. It is useful for such work as potato planting, lifting and sorting, mangold pulling and hoeing, etc. Patients also assist with the pigs and occasionally with the herd.

As regards the regular hands, eleven men are employed. Three of these are in charge of patients working on the farm; three attend to the cows, milk, and fill in their time with seasonal farm work; one is in charge of the pigs; two are carters; one looks after the poultry and does general work; and one is permanently engaged carting coal, etc.

Cropping.—Of the 72 acres under permanent grass 40½ are made into hay each year. For the greater part this meadow land is rather low-lying, and considering the district yields fair crops.

The young stock are sent off the farm for the summer and do not return until the end of September; during this time, therefore, the 33 cows, sows and gilts, have access to about 32 acres of pasture and the aftermath of 40½ acres. The pasture is, however, very poor and cannot be relied on to produce much keep in unfavourable times; it is supplemented by green crops from the arable land fed either on the pastures or more usually in the cow sheds.

On the low-lying meadows applications of basic slag have been found to be the most effective method of improving the herbage, dressings of 5-6 cwt. of a 30-40 per cent. grade being given every three or four years.

The pasture land is much drier and manuring of this is much less effective; occasional liming and frequent small applications of soluble phosphates and potash form probably the most effective treatment. A dry season on these soils burns out fine grasses and clovers, and the surface then soon covers itself with moss.

A relatively large number of cattle, which are chiefly fed on green crops grown on the arable land, graze over the meadows and pastures, and it is their droppings which have gradually added to the fertility of these fields, enabling them to produce more herbage than they otherwise would.

Of the 82 acres of arable 7 comprise land which is unsuitable

for winter cropping; of these 2 acres are irrigated by liquid manure from the buildings, and 5 acres are on land which is naturally wet. This area is cropped specially with such crops as mangolds, spring planted cabbage, maize, kale, etc.

The remaining 75 acres are cropped and manured in the usual way of farm practice, but no strict rotation of crops is followed. Each year it is necessary to grow from 20 to 22 acres of potatoes, of which 2-3 acres are earlies, so that part of the ground has potatoes every third year and part every fourth. A strict rotation is therefore impossible.

The area under the various crops during the season 1922-23 was as follows:—

	Acres.	*Soiling Crops.*	Acres.
Potatoes	20¼*	Maize	2
Wheat	8	Rye	2
Winter Oats ...	15†	Trifolium	1
Rye	4	Winter Vetch Mixtures	3½
Seeds Ley	13½	Spring Vetch Mixture ...	1¾
Mangolds	8		
Cabbage	3		

The soiling crops were followed by 2 acres swedes, 3 acres turnips, and 3¼ acres kale.

Summarised this is :—Potatoes 20¼ acres, straw crops 27 acres, seeds 13½ acres, roots and green fodder crops 21¼ acres, part of the last being followed by 8 acres roots and kale.

Of the produce from these crops, the bulk of the potatoes, the greater part of the 3¼ acres of kale, and practically all the swedes and turnips were taken by the Institution. With the exception of a few potatoes sold for seed all the other produce, including the wheat, was consumed on the farm.

Potatoes.—The requirements of the Institution are approximately ½ ton per day or 180 tons per year, and the average yield in 1922 was 10 tons per acre. The varieties grown are Epicure for earlies, King Edward, Ally, Lochar and Great Scot. Scotch seed is always used, and the ground is well manured, a common dressing being farmyard manure 20 tons, superphosphate 3 cwt., sulphate of potash 1½-2 cwt., sulphate of ammonia 1 cwt.

Wheat.—An area of wheat is always grown, and of late years Yeoman has been found to be very satisfactory.

Winter Oats.—These are grown to provide straw fodder for the cattle and grain for horses. Spring oats are not very satisfactory on this land, and are not now grown here.

* Of this 2¼ acres were earlies.
† Of this 11 acres were sown with seeds.

Rye.—A small area is cultivated for straw and grain as it grows well on this land, and if there is a scarcity of fodder in the early summer it can be used as green food.

Clover and Rye Grass Ley.—A one-year's mixture is grown containing broad red clover, alsike and Italian rye grass. Two cuts are taken in the summer before the ley is broken up.

Mangolds.—These are used for the cows from Christmas until about the middle of April. They also form part of the ration of the young stock and some are given to pigs. This crop is manured very similarly to the potatoes, except that the sulphate of potash is replaced by the requisite amount of kainit and a top dressing of nitrate of soda may be given at singling time.

Cabbage.—This is fed to the cows from October to December, replacing the green maize in the rations. This crop is grown under the sewage irrigation.

Soiling Crops.—Maize is grown under sewage irrigation and is a most valuable crop on this farm, supplying green food during the period from August to October, when so often the grass is scarce or has lost its succulence.

Strips of rye. trifolium and vetch mixtures are sown in the autumn for early feed from April onwards. Spring vetches with oats are sown in the spring to follow these, and to carry on until the aftermath is available and the maize is ready for feeding in August. These crops are followed by kale, swedes and turnips, the bulk of which is required by the Institution and the remainder is used up as food for stock after the cabbage has been finished and before the mangolds are started at Christmas. Where the pasture is so poor these crops are essential if a large herd of dairy cows is to be maintained on a relatively small acreage. These soiling crops are well manured, receiving a dressing of farmyard manure with the addition of some superphosphate and occasionally a small quantity of sulphate of ammonia or nitrate of soda.

Manuring.—The yields of all crops on the farm have gradually been increased, and there is no doubt that this is very largely due to the great improvement which has been brought about in the condition and texture of the soil by the frequent application of farmyard manure. This supplies the organic matter which is absolutely essential to this soil, helping it to retain its moisture, without which no heavy crop can be grown, however great the application of artificials may be. The application of so much farmyard manure has been made possible by the wintering of a large head of stock. From 8 horses, 60 head of cattle and

about 400 pigs of varying ages, about 830 tons of manure are produced annually; of this 50-80 tons are required by the gardens, the remainder being used on the farm for potatoes, mangolds and soiling crops.

About 12½ tons of artificials, comprising superphosphate, kainit, sulphate of potash, nitrate of soda, sulphate of ammonia and potato fertilisers, are used annually on the arable land. About half of this weight is applied to the potato ground, the balance being used for mangolds, other root crops and soiling crops. Basic slag is applied to the grassland in such a way that the whole is treated about every four years.

Feeding of the Stock.—*Horses.*—The rations for the horses consist of seeds hay, straw chaff and oats in winter, and soiling crops, hay and oats in summer. All these are grown on the farm.

Cows.—In summer the cows graze over about 32 acres of pasture and 40½ acres of aftermath, and are given the produce of about 7¾ acres of soiling crops.

The approximate average per cow is therefore as follows:—pasture 0.97 acres, aftermath 1.23 acres, soiling crops 0.22 acres. The soiling crops providing the continuous supply of green food are rye, trifolium, winter vetch mixture, spring vetch mixture and maize. The cows also receive some concentrates, the quantities being varied according to the milk yield of individual cows.

From October the winter green foods are cabbage followed by kale, swedes and mangolds in turn, the last carrying on until the rye and trifolium are available. Meadow hay, oat straw and purchased concentrates complete the winter ration. The amount of concentrates required per cow for the whole year ended 31st March, 1923, was 0.90 ton, or an average of 5.5 lb. per day.

The food values of these rations have been worked out on several occasions, and it has been found that the cows are being fed for maintenance and milk yield on lines very near to the standard of scientific requirements.

Pigs.—Sows and gilts are kept in the open air on waste and pasture land as far as is practicable. They are brought into the sties to farrow. Pigs for fattening are kept indoors from weaning time. Green food or roots are given throughout the year, and small potatoes from the farm when available. Swill from the Institution is utilised to the full. The ration is completed by purchased foods comprising bran, middlings, barley meal, pig meal, etc.

It was found during the past year that the total quantity of concentrates required for the pigs worked out at an average of 2.86 lb. per day for 276 pigs, a number which comprises sows, gilts, boars and fatteners, but excludes suckers, and is fairly constant throughout the year. This small average testifies to the use made of small potatoes and swill.

Accounts.—Detailed farm accounts are kept, and for this purpose the farm year is from April to March. In many respects this is an advantage as the annual valuation does not then include large sums for hay, straw, corn, potatoes, etc., which would affect one taken at Michaelmas. The farm is credited with the cost of produce taken by the Institution at current wholesale market prices.

Conclusion.—Financially the farm has been a success. Its main source of profit has been from pigs, whose well-known ability to convert swill and waste potatoes into a saleable commodity has been utilised to the fullest extent, as is shown by the small average daily requirement of meals. A further source of profit has been milk production, and on this farm it is due to the high average yield of the herd, furthered by sound feeding on scientific lines. The farm, moreover, fulfils its purpose very adequately, though in many respects it is not favoured by natural conditions, as the soil is poor and dry, and the average rainfall of the district is low. An intimate knowledge of the farm and its methods reveals very clearly how much of its success in all its branches is directly due to the consistent following of a definite policy. A readiness to profit by practical experience and scientific information has always been shown, but no radical changes have been allowed to affect the general scheme in operation which time has shown to be sound.

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LUCERNE.

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II.

Date, Rate and Methods of Seeding.—It is generally recommended that lucerne should be sown in drills, although when the conditions are favourable excellent stands can be obtained from broadcasting; this latter method, however, should not be employed except when the land is exceptionally free from weeds: under poor and average conditions drilling is much to be preferred.

A grain drill with seeder attachment may be used. In America special alfalfa disc drills are largely employed. The chief merit of drilling is that it affords ample opportunity for hoeing and weeding the crop during its early development, and also ensures proper covering of the seed—the correct depth being an inch or a little under on heavy soils, and about 1¼ to 1½ inches on light sandy soils. The seed rates employed vary over a wide range in different parts of the world. In Sweden Witte's trials indicate that for broadcasting about 35 to 40 lb. per acre, and for drilling about 25 to 30 lb. per acre (with the coulters about 10 in. or 13 in. apart), are the correct rates. In America under normal conditions the seed rate for drilling is about 20 to 25 lb., while under irrigation the quantity may be as little as 15 lb. In drier districts in New South Wales the seed rate is often as low as 6 to 8 lb.* The rates for normal conditions are higher than those usually employed in the case of red clover, but somewhat heavy seedings are necessary in order to assist weed repression. The distance between the drills should be sufficient to allow of proper hoeing; thus Witte recommends a minimum of about 10 in. with a range up to 13 in.; distances commonly employed vary from about 6 in. or 7 in. to as much as 21 in. The establishment of a successful stand on a sandy soil has been reported by the Harper Adams Agricultural College, when 20 lb. per acre was sown in drills one foot apart.† Oldershaw‡ recommends broadcasting on heavy clays, since on such soils cultivation is usually difficult and is likely to be injurious to the plants.

Trials conducted in New Zealand have shown the advantage of drilling over broadcasting. At Canterbury plots drilled at 14 in., inoculated and manured, yielded more heavily than those drilled at 7 in. or 21 in. On the unmanured and non-inoculated plots, 21 in. gave the highest yields.§ In America the growing of lucerne in widely-spaced rows has not proved profitable, for the cultivations have then to be continued over the whole duration of the ley and consequently become prohibitive‖ while the crop is liable to become very dusty. Fream quotes opinions in favour of drilling at from 6 in. to 8 in., any

* See Whittet, J. N., "The Production of Lucerne Seed," Agric. Gazette of New South Wales, Vol. XXXII, p. 105.

† The Harper Adams Agricultural College, "Field Experiments," 1911.

‡ Oldershaw, A. E., "Lucerne as an Alternative to Grass," Agricultural Gazette, 26th March, 1923.

§ Ward, F. E.: "Some Recent Lucerne Experiments in Canterbury," New Zealand Jour. Agr., Vol. 24, 1922, p. 226.

‖ Oakley, R.A. and Westover, H. Q.: "How to grow Lucerne," U.S. Dept. Agr., Farmers' Bull. No. 1283.

greater distance being stated to favour a straggling rather than an upright growth of the plants.* The results at Aberystwyth tend to show, however, that lucerne can be grown by the widely spaced method under general conditions unsuited to the crop and it is a plan worthy of further trial as being of possible value to those who desire, at all events, to grow a relatively small breadth of lucerne only, as an insurance against exceptionally dry years. In the drier regions of New South Wales, it is recommended by Whittet† that lucerne for seed production should be grown in rows spaced by as much as 30 in. to 36 in. when only 1½ lb. to 2 lb. of seed per acre are employed. It is of interest to note that in 1826 Cobbett‡ refers to an area of lucerne grown in Herefordshire "on the Tullian plan" in rows 4 ft. apart, and he remarks that "a good crop of early cabbage may be had between the lucerne rows"—a useful reminder that there are many ways of growing forage crops!

Lucerne should be sown early enough to have become well established before the end of the growing season, and late enough to have allowed ample time for the destruction of weed seedlings before sowing. In this country June is probably the best month for sowing. Trials conducted by Witte at Svalöf from sowings made at seven different dates between 18th June and 15th September showed the best results from the first two dates (18th June and 5th July), with an eleven per cent. drop by 15th July and thence a rapid and progressive fall to 15th September—from sowing at which date no stand was achieved.§

It is not generally advisable to sow lucerne under a covering crop; for one thing this necessitates early sowing and prevents adequate cleaning of the ground; it also necessitates a higher seed rate and tends to interfere with the establishment of a satisfactory stand. The crop should only be sown under a "nurse" crop when the conditions are particularly favourable. Witte's trials show a decrease of .21 per cent. from three cuts taken in the first two years from sowing under a nurse in comparison with no nurse,§ whilst Wright's trials in Scotland proved the nurse crop to be destructive to the lucerne.

* Fream, W., "The Cultivation of Lucerne in England," Jour.R.A.S.E., 1895.

† Whittet, *loc. cit.*

‡ Cobbet's "Rural Rides."

§ See Witte, Hernfrid, "Blålusernodlingen i Nordamerika," Stockholm-Svenska Tryckeriaktiebolaget, 1921. Note: 316 references to Lucerne literature (mostly American) are given in this paper.

After-Management.—The chief aim of after-management is to keep down weeds and to bring the plants into the best condition for withstanding the winter, both of which are of the greatest importance during the seeding year. When sown without a nurse and in drills, the ley should be hoed several times during the first summer with a hand or horse hoe, and if necessary hand weeded also. In the first harvest year hoeing should be started as early in the spring as the condition of the soil permits, and if necessary hand hoeing should be resorted to and the process be repeated after the first cut, and if need be, again after the second cut. These hoeings are doubly important in regions of high rainfall (a necessity which affords a strong argument for sowing lucerne in drills in such situations) where weeds grow rapidly, and generally where the conditions are not particularly favourable to lucerne. Harrowing as a means of keeping down weeds is not to be recommended until after the first harvest year as there is too great a risk of injuring the young plants.

Subsequent to the first harvest year, harrowing or other methods of cultivation should be resorted to with a view to keeping down weeds. As to whether harrowing is beneficial, apart from weed destruction, is doubtful, and it is not recommended by Oakley and Westover on broadcast leys, neither is it considered to be a sound practice under South African conditions.* Harrowing is recommended by Witte and Elofson in the second and subsequent harvest years (when the leys have been drilled) and should probably be regarded as an important operation under high rainfall conditions in this country, both with a view to the suppression of weeds (especially bent and other grasses), and the breaking of the consolidated soil surface and consequent aeration. If the soil is not in a suitable condition when the lucerne is commencing active growth in the spring Witte recommends harrowing immediately (within two days) after the first cutting, and if possible again after the last cut of the season.

Suitable implements must be used, and the tines of the harrow should not be too sharp. Oakley and Westover state that experience has shown that in most cases the use of the disc harrow is actually injurious and that this or any implement that tends to split the crowns should be avoided.

* See Reid, V. D.: "Lucerne Growing in Vincent County," New Zealand Journal of Agriculture, Vol. XXVI, 1923, p. 219.

Practice with reference to the treatment of the crop and utilisation of the produce during the seeding year is varied in the extreme. Experiments in Sweden indicate that under the conditions there obtaining it is best not to cut during the seeding year; if, however, the seeding has been early and the plant is in or near flowering stage, a cut can be sometimes taken at the end of August or early in September. In the Southern States of America, where lucerne grows rapidly from spring sowing, it is often possible and advantageous to take two or even three hay cuts during the seeding year. It is sometimes a common practice to cut over the leys in the seeding year once or even twice whilst still young, with the intention of keeping down the weeds and encouraging the young plants to "stool out." Work recently conducted by McKee,* however, seems to suggest that clipping has the reverse of beneficial influences on the young lucerne plants, resulting in a reduction of root system and loss of vigour during the subsequent (first harvest) year and it would appear that in no case (even despite excessive weediness) should a cut be made until the plants are coming into flower.

When fields are not cut during the growing season of the seeding year, various practices obtain for dealing with the dead growth which will be apparent during late autumn and early winter, Witte states that the dry stems should be raked together early in the spring, and in the Northern States of America, where the hardy variegated lucernes are grown, the fields are sometimes burned over early in the spring. In the dry Vincent country in New Zealand the stand is not infrequently cut when 5 in. to 6 in. high and the growth and weeds left on the ground to act as a mulch during the winter.†

In the second and subsequent harvest years lucerne is most usually cut two, three or even four times for hay or green fodder. Frequent cutting, however, has the effect of diminishing the persistency of the ley, and even under the most favourable conditions more than three cuts will tend in this direction, while under conditions less suited to lucerne cultivation it is not advisable to cut more than twice per season if it is desired to maintain a long duration ley.

The heaviest yields will be obtained from cuttings made when the crop is in full bloom, and; particularly on young leys, cutting

* See McKee, Roland, "The Effect of Clipping on the Root Development of Alfalfa," Jour. Amer. Soc. Agronomy, Vol. 8, 1916, p. 329, Investigations in progress at Aberystwyth with cocksfoot and other grasses show that repeated cutting has a very detrimental influence on the root development of plants so treated.

† See Reid, *loc. cit.*

too late or too early has equally bad effects on persistency and is not to be recommended; in particular cutting before flowering time is fatal to persistency. As a rule the crop should be cut when about one-third and not more than one-half of the stand is in flower, a procedure which is compatible with the saving of fodder of high nutritive value, and with safeguarding persistency.

Although lucerne is essentially a hay and soiling crop, as previously stated, it is used to a considerable extent as pasturage in many parts of the world. It is generally recommended that lucerne should not be grazed in the first harvest year, and it is an established fact that it should not be grazed continuously or allowed to be eaten down to the crowns.

Lucerne in Mixtures.—Grasses and clovers may be sown together with lucerne for one of two purposes:—either to add to the keep during the seeding and first harvest year only, and to suppress weeds during that period, or to grow with the lucerne during the whole period of the ley. Lucerne is sometimes used as an ingredient in ordinary mixtures intended for long duration leys.

Ordinary Mixtures.—Lucerne in amounts varying from 3 lb. to 10 lb. per acre is often included in mixtures of the Elliot type, and frequently justifies itself on chalky and gravelly soils. Its inclusion in such mixtures regardless of soil and other conditions is, however, from the point of view of its contribution to the hay crop, in many cases merely a waste of seed. A mixture consisting of tall oat grass 5 lb., Vale of Clwyd red clover 7½ lb., and lucerne 15 lb. per acre, was sown in 1922 at Aberystwyth. The lucerne brairded fairly well, but never looked healthy during the seeding year, and in the first hay crop (1923) only contributed 0.42 per cent. to the total produce. In general, it may be said that the lucerne in ordinary mixtures sown under non-lucerne conditions will do less well than if sown alone. Elofson with considerable justice none the less advocates the inclusion of lucerne in ordinary mixtures, simply as an index plant, to ascertain whether lucerne succeeds on particular fields and in particular districts, and, if succeeding, by degrees to increase the nitrogen bacteria. Where appreciable contributions result pure lucerne leys should be subsequently tried.

The Addition of Grasses or Clovers to suppress Weeds during the Seeding and First Harvest Years of a Lucerne Ley.—With this end in view short lived grasses or clovers are usually employed, and as the result of trials conducted by Lindhard in

Denmark it would seem that the contribution of the short lived species should be but slight and that of the lucerne considerable.*

Broad red clover (successfully employed at Saxmundham), Italian rye grass, and quite small sowings of tall oat grass, have been employed, while in this country trefoil is sometimes used, and small sowings of wild white clover have been tried.

There is always some risk of the quick growing plants sown competing adversely with the lucerne as effectively as would weeds—it would therefore seem desirable to rely on hoeing when the lucerne is drilled and only to include small amounts of a quick growing species when lucerne is broadcast on a field known to have been insufficiently cleaned.

Lucerne-Grass Leys in Place of Pure Lucerne.—Under certain conditions a lucerne-grass ley may be more profitable than a pure lucerne stand, and in any event has certain advantages to recommend it. The various operations connected with hay-making can be carried out more easily—an important consideration in regions of rather high rainfall. The ration is more varied, which is an advantage for certain purposes. In addition, weeds may to some extent be suppressed, and such leys generally establish themselves when broadcast better than pure lucerne; the necessity for hoeing and cultivation is thus obviated, and in certain localities the crops are somewhat heavier.

A lucerne-grass ley can with advantage replace a late-flowering red clover-grass ley intended for, say, three years, on soils which are too dry to carry good crops of red clover. For land where it can be shown that a lucerne-grass ley gives a greater bulk of forage than pure lucerne over a long period of years there is of course much to be said in favour of the combination. Soils rich in humus are best suited to long duration lucerne-grass leys, which would not seem to be well adapted to very dry soils, or to regions of particularly low rainfall.

It is probably best to combine but a single grass with lucerne. The species chosen should be persistent under meadow conditions, should recover rapidly after cutting, and yield two good cuts a year, while it should also come into flower at about the same time as the lucerne. Timothy is somewhat largely employed for this purpose in America, but can hardly be regarded as a very suitable species in England, since it flowers too late and does not recover particularly well after cutting. Witte refers to interesting trials conducted at Alnarp (by Forsberg) and at

* Lindhard, E., "Forsög med Kaellingetand og i Lucerne Graesblanding," Tystofte, 1910–13.

Svalöf, which indicate that cocksfoot and tall oat grass are perhaps the best grasses for the purpose—a combination of lucerne with each having given higher yields over a six-year period (1915-20) at Alnarp and in the first harvest year (1920) at Svalöf than pure lucerne. The following relative statement taken from Witte shows the state of affairs at Alnarp* :—

Lucerne alone	... ...	100·0	Based on total produce for the six-year period.
Lucerne and cocksfoot	...	132·4	
Lucerne and tall oat grass		138·3	

Other Swedish trials also indicate that tall oat grass with lucerne gives on the average slightly heavier yields than cocksfoot. Cocksfoot, however, gives a more leafy hay than tall oat grass and also stands grazing better, and in this country is likely to give the better results. Before the era of the motor lorry, market gardeners in parts of Kent used to grow cocksfoot-lucerne leys for their horses, and the writer has seen excellent examples of these near Greenhithe from which heavy hay crops were taken twice a year, while Oldershaw quotes a case of a lucerne-cocksfoot ley which has given excellent results over a nine-year period.†

The mixtures employed in Sweden have varied from 2½ to 7 lb. of cocksfoot—about 4½ lb. having apparently given the best results—with 18 to 27 lb. of lucerne per acre. Tall oat grass is generally employed at the rate of 7 to 10½ lb. in mixtures with lucerne.‡ Were it not for the high price of the seed golden oat grass would probably also be a good species to employ in conjunction with lucerne.

The Improvement of Lucerne.—It is beyond the scope of this article to enter into details with reference to breeding lucerne, but there are certain considerations that should be of interest to the general reader. It must be remembered in the first place that the variegated lucernes of commerce are all natural hybrids, and that they have not been bred carefully from segregates obviously suited, after selection, for particular districts. Thus, even supposing that Grimm or other commercial varieties of the natural hybrids were proved to be no gain on Provence for any one of the varied habitats obtaining in Britain—this would not be evidence that it would be impossible or even difficult to breed a hybrid lucerne of extreme value for some of our more difficult habitats.

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* See Witte "......................... ....i Nordamerika," *loc. cit.*

† Oldershaw, A. W., "Lucerne and its many good Qualities," Modern Farming, July, 1920.

‡ Trials at Aberystwyth of Tall Oat Grass with Red Clover have also shown that this grass needs to be sown in larger amounts than Cocksfoot.

Such selection as has so far been operative on the commercial lucernes has been in favour of drought resistance and frost resistance, neither of which is of supreme importance, except perhaps in restricted areas, in Britain. The case for the prosecution of critical breeding work with lucerne in this country is based not only on the great value of the crop but on the almost accidental success of the variegated types in North America, and on the fact that lucerne, almost alone of the herbage and forage legumes and grasses, appears to be an ideal species for the plant breeder. The technique of fertilization is simple, and, given the necessary mechanical assistance, it is a self-fertile plant.*

Summary and Conclusions.—1. It is evident from a review of the literature cited in this paper that lucerne is a crop of exceptional importance, and judging by the scant reference to it in the agricultural literature of this country it would appear to be equally evident that not enough attention has been given to the possibilities of increasing the area under lucerne in Britain.

2. It is not to be supposed that lucerne could be successfully grown in all districts, or on every farm in particular districts, but having in mind its great value, especially in years of drought, it would be to the interest of most stock farmers to endeavour to maintain at least a small area of lucerne on their holdings.

3. Investigation is necessary in the direction of thoroughly testing the most promising nationalities and strains over the widest possible area in the country. Hungarian lucerne, with Grimm and other representatives of the variegated lucerne should be tried against Provence. These trials should be followed up by

* The following papers may be cited as amongst those which give the most useful information relative to Lucerne breeding :—

Southworth, W.—"Alfalfa Hybridization," Scientific Agriculture (Canada), Vol. II, 1922. p. 257, and Journal of Heredity, Vol. V (10), October, 1914.

Oliver, G. W.—"New Methods of Plant Breeding," United States Department of Agriculture, Bureau of Plant Industry, Bull. 167, 1910.

Piper, C. V.—"Alfalfa Seed Production : Pollination Studies," United States Department of Agriculture, Bureau of Plant Industry, Bull. 75, 1914.

Witte, Hernfrid—"Alfalfa Breeding : Its Possibilities and Purposes in Sweden and some Observations concerning different Characters in the Crossing between the Blue-Flowered Alfalfa *(Medicago sativa)* and the Yellow-Flowered *(M. falcata).*" (Summary in English), in Sveriges Utsädesforenings Tidskrift, Häfte V, 1921.

Waldron, L.R.—"Cross-Fertilization in Alfalfa," Journal American Society of Agronomy, Vol. XI, 1919, p. 259.

————"First Generation Crosses between two Alfalfa Species," ibid., Vol. XII, 1920, p. 133.

research with a view to breeding improved strains suitable to those areas where it is at present difficult or impossible to grow the crop with reasonable success.

4. Cultural methods need also to be made the subject of exhaustive and careful investigation, of particular importance being the question of the rival claims of broadcasting, drilling and growing in spaced rows, under different conditions of soil and climate.

5. Equally important is the question of the best and most economic means of inoculation, and the relation of applications of lime and of manurial dressings to yield as such and to the necessity for or efficiency of inoculation under varied conditions.

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FEEDING TRIALS WITH SILAGE.

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IN 1920, Mr. A. H. Chaytor, M.A., of Hurst Green, Sussex, presented a tower silo (Fig. 1) to the College for experimental purposes, and during the years 1921-22 and 1922-23 trials have been carried out which were designed to obtain information regarding the economic value of silage. In both years the silage was tried against roots. All the foods used were analysed and, with the exception of the silage, their compositions were sufficiently near to the average figures in the tables published by the Ministry,* for the latter to be used in compounding the rations. In the case of the silage the rations were based on the actual analyses.†

The Composition of Oat and Tare Silage.—The analysis of oat and tare silage was found to vary considerably, not only from year to year, but in samples taken at different heights in the silo. During the years under discussion it was very noticeable that the composition of a crop of oats and tares at the time of cutting depends principally upon the weather during growth. In the year 1920-21 the early part of the summer was dry and the tares made poor growth, the proportion of tares at the time of cutting being small, but in the year 1921-22 when the weather

* See tables in the Ministry's Miscellaneous Publication No. 32, "Rations for Farm Stock."

† The digestible constituents were calculated by the use of the co-efficients of digestibility determined by Wood and Woodman (Jour. Agr. Sci., July, 1921).

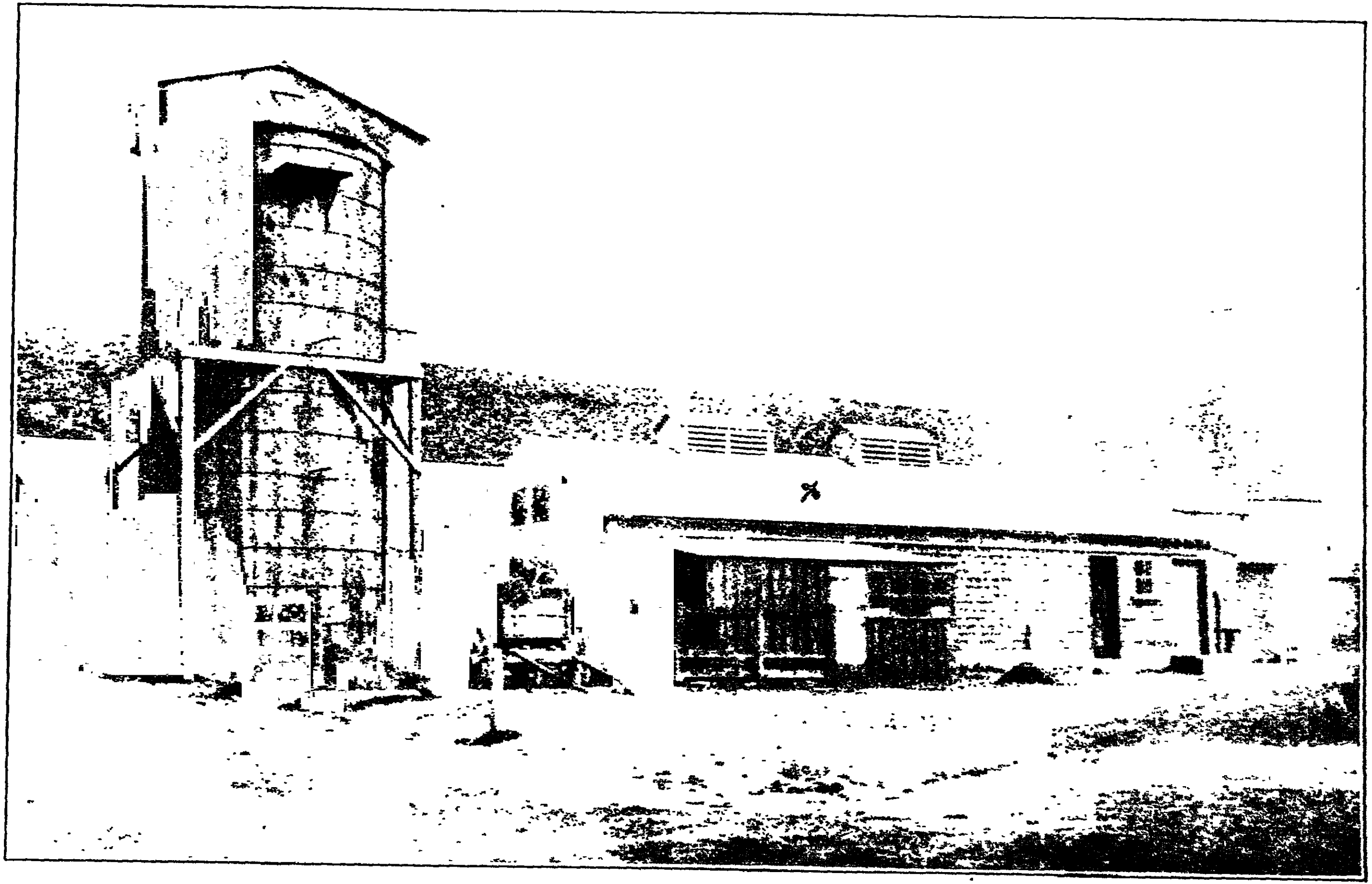

Fig. 1.—Farm Buildings at Wye, showing the Silo and the Cow-house

was showery the tares grew vigorously and formed the bulk of the crop. The quality of silage is dependent partly upon the kind of green material put into the silo and partly upon its condition,* the latter being governed very largely by the weather at the time of cutting. It will be readily understood therefore that the composition of oat and tare silage is very variable, and if it is to be used to the best advantage, rations must be based on actual analysis.

Density of Oat and Tare Silage.—Numerous inquiries have been received regarding the capacity of silos and weight of silage. The College silo is 14 feet in diameter and 32 feet high. In 1920-21 it contained 24 feet of usable silage after it had settled, weighing† 67 tons; that is to say, about 55 cubic feet of silage weighed 1 ton. In 1921-22 there were 21 feet of usable silage weighing 59 tons; that is, 54 cubic feet weighed 1 ton.

Costs.—The cost of the production of silage used in the succeeding pages includes all expenses incurred in growing, harvesting and storing the green material, but does not include the cost of removing the silage from the silo and of feeding. The cost of roots includes all the expenses up to the time they arrive in the root store, which adjoins the mixing room, but does not include the cost of cutting and feeding. The method of dealing with the silage at Wye is as follows:—A trolley is placed under the shoot so that the silage as it is thrown out of the silo falls into the trolley. Two men are employed, one in the silo throwing the silage down the shoot, and one packing it into the trolley and wheeling it away. The silo adjoins the buildings (Fig. 1). It is about 20 yards from the silo to the food store. With regard to the roots two men are employed to cut them, one to fill the cutter and the other to remove the cut roots. The cutter is driven by an engine.

In 1922-23 the above operations were timed and the following notes were made:—

1. It was found to take about twice as long to cut the roots for a number of cows as it did to bring the silage for them from the silo.

2. The cost of running the engine was saved in the case of the silage.

* Amos and Williams, Jour. Agr. Science, Vol. XII, Pt. 4.

† The weight was ascertained by keeping a record of the number of trolley loads taken from the silo, a trolley load being weighed periodically.

3. The weight which had to be distributed amongst the cows was less with the silage ration than with the root ration. With a small head of stock, such as was employed in these trials, it is impossible to estimate with any degree of accuracy the amount of time saved by using silage instead of roots, but from the observations made it is evident that in the case of a large head of stock the saving in this direction would be considerable. This should be borne in mind in considering the figures regarding cost given in the subsequent pages.

Soil and Climate.—The crops described in this paper were grown upon a light working clay soil overlying the chalk, which in places is only a few feet below the surface. The rainfall of the district is low, about 30 inches per annum.

Feeding Trial with Dairy Cows in 1921-22.—The 1920-21 crop was sown on 25th February at the rate of 2½ bushels of tares and 1½ bushels of oats. It was manured with 6 cwt. of slag (30 per cent.), 4 cwt. of kainit, and 1 cwt. of sulphate of ammonia. It was cut on 4th July in hot weather, and was allowed to lie in the swath for about 12 hours to wilt before being carted. The tares did not grow well, and at the time of cutting tares and oats were in about equal proportions. The tares were in full flower and the oats had reached the milk stage. It was not possible to take any weights, but the crop was estimated, by eye, to be about 8 tons of green material per acre.

The silage when removed from the silo was brownish in colour, had a pleasant smell, and was readily eaten by all kinds of horned stock. The quantity of usable silage (67 tons) is equivalent to 6 tons per acre. After the silage crop had been harvested the land was ploughed and sown with turnips and rape, but these failed owing to the dry weather. In this year swedes failed and mangolds yielded 15½ tons per acre.

*Rations.**—Each cow received a basal ration, which was arranged to provide sufficient nutrient materials for the maintenance of the cow† and to enable her to produce her calf. It consisted of :—

When on Silage.	*When on Mangolds.*
3 lb. Straw.	9 lb. Straw.
6 „ Hay.	8 „ Hay.
45 „ Silage.	56 „ Mangolds.

and in addition to the above 2 lb. oats, 1 lb. Egyptian cotton

* These were compounded on the lines laid down in Leaflet No. 388, the dry matter content being checked by the curves given in Miscellaneous Publication No. 32.

† Average weight, 10 cwt.

cake and 1 lb. linseed cake were fed *for each gallon of milk yielded.*

Only six cows were available for this trial. They were divided into two groups—A and B—with 3 cows in each group, the cows being matched as nearly as possible as regards age, lactation period, and size. The rations were weighed out each day. The milk was weighed as it was drawn from the cows. The cows were fed as follows :—

	Period.	*Group A.*	*Group B.*
Preliminary period ...	Jan. 9 to Jan. 22. ...	Roots.	Silage.
1st Trial period	Jan. 23 „ Feb. 27. ..	„	„
	Feb. 28 „ Mar. 12. ...	Foods changed.	
2nd Trial period	Mar. 13 „ Apl. 16. ...	Silage.	Roots.

The milk yields were :—

	Silage.	*lb.*	*Roots.*	*lb.*
1st period	Group B :	3,372 ...	Group A :	3,360
2nd period	„ A :	3,368 ...	„ B :	3,386
Total ...		6,740 ...		6,746

*Costs.**—The cost of silage was £2 7s. 6d. per ton and that of the mangolds £1 7s., and on this basis the cost of the food consumed to produce 1 gallon of milk was the same with both the mangold and the silage rations, viz., 10d. In considering the question of costs, it should be borne in mind (1) That in 1921 in this district both cabbages and swedes were a failure; (2) Silage was the only succulent food available in any quantity between September and Christmas; and (3) The price of £1 7s. was the actual cost of producing the mangold crop, but in order to get a fair comparison between silage and roots the mangolds should be charged at the average price of producing a ton of roots (*i.e.* average of swedes and mangolds), which was about £2 10s. as the swede crop was a failure. If the roots used are charged at £2 10s. per ton, the cost of producing a gallon of milk comes to 1s. per gallon.

Feeding Trials with Dairy Cows in 1922-23.—The seed for the 1921-22 crop was drilled on 29th October at the rate of $2\frac{1}{4}$ bushels of tares and 1 bushel of oats. Six cwt. slag (30 per cent.), and 4 cwt. of kainit were applied to the land before sowing, and 1 cwt. of sulphate of ammonia was applied as a top dressing in the spring. The crop was cut and carted between

* Hay was valued at £5 per ton, straw at 50s. per ton, oats at 35s. per qr., Linseed cake £14 15s. per ton, Egyptian cotton cake £9 5s. per ton. The cost of silage and roots were ascertained by H. W. Kersey on the lines laid down by C. S. Orwin in his book on Farm Costings, and in considering these it should be remembered that wages have fallen since 1922.

16th and 22nd June in showery weather. It was allowed to lie in the swath for about 24 hours before carting, but did not dry much. The material which was put into the bottom of the silo was wet with rain which fell just before and during carting. The oats had not made much growth, and the crop consisted mainly of tares, which were in full flower at the time of cutting. The weight of freshly cut green material was estimated to be 7 tons 6 cwt. per acre.

The silage was a dark greenish brown, almost black, colour, with a very distinctive smell: that from the upper part of the silo was quite palatable, but at the bottom where the green material was carted when wet with rain the silage was darker in colour, had a more pronounced smell and was eaten with less relish than that from the upper portion. The weight of usable silage taken from the silo (59 tons) is equal to a yield of nearly 5 tons per acre.

After the silage crop had been removed the land was ploughed and sown with white turnips, which yielded 15 tons per acre. In this year swedes yielded 20 tons per acre and mangolds about $24\frac{1}{2}$ tons.

Rations.—The basic ration was arranged to provide sufficient nutrient material for the maintenance of the cow* and to enable her to produce 1 gallon of milk per day in addition to her calf's needs. It consisted at the commencement of the trial of :—

When on Silage.	*When on Mangolds.*
6 lb. Straw.	6 lb. Straw.
8 ,, Hay.	12 ,, Hay.
45 ,, Silage.	84 ,, Mangolds.
	2 ,, Egyptian cotton cake.

and in addition to the above each cow received 2 lb. of oats, 1 lb. of Egyptian cotton cake and 1 lb. of linseed cake *for each gallon of milk yielded in excess of* 1 *gallon.*

The silage from the bottom of the silo proved to be of poorer quality than that from the upper portion and, at the end of April, it was necessary to add 2 lb. of Egyptian cotton cake to the silage ration to bring the protein up to the theoretical standard.

Eight cows were available for this trial and these were divided into two groups—C and D—with four cows in each group. During the first change period Number 18 (in Group D) had an attack of indigestion and her milk yield was abnormal for about a fortnight.

* Average weight 11 cwt.

Rations were weighed out each day. The milk was weighed as it was drawn from the cows. The cows were fed as under :—

		1923.		Group C.	Group D.
Preliminary period	...	Jan. 22 to Jan. 29	...	Mangolds.	Silage.
1st Trial period	...	Jan. 30 „ Feb. 19	...	„	„
		Feb. 20 „ Feb. 26	...	Food changed.	
2nd Trial period	...	Feb. 27 „ Mar. 19	...	Silage.	Mangolds.
		Mar. 20 „ Mar. 26	...	Food changed.	
3rd Trial period	...	Mar. 27 „ Apl. 16	...	Mangolds.	Silage.
		Apl. 17 „ Apl. 23	...	Food changed.	
4th Trial period	...	Apl. 24 „ May 15	...	Silage.	Mangolds.

The milk yields were :—

			Silage. lb.		Mangolds. lb.
1st period ...	...	...	Group D : 2,943½	...	Group C : 2,806½
2nd period ...	...	...	„ C : 2,507¾	...	„ D : 2,876¼
3rd period ...	...	...	„ D : 2,750½	...	„ C : 2,572¾
4th period ...	...	...	„ C : 2,372¾	...	„ D : 2,920¾
			Total 10,574½	...	11,176¼

showing a difference in favour of the mangold ration of about 60 gallons (5 per cent.).

The difference in the milk yields was undoubtedly to a certain extent accounted for by the deterioration which took place in the quality of the silage during the trial. In the earlier part of the winter the silage improved in quality the lower it came from in the silo, and in framing the rations after Christmas, allowance was made for a further improvement. The material at the bottom of the silo, however, proved to be of poorer quality.

*Costs.**—The cost of production of the silage was £2 10s. per ton and that of the mangolds 15s. 8d. per ton. On this basis the food used to produce 1 gallon of milk cost 8¾d. with the silage ration, and 8d. with the mangold ration.

Quality of Milk.—The opinion is held by some feeders that silage will taint the milk of cows to which it is fed. This opinion has not been confirmed at Wye. On no occasion has any bad flavour been noticed and during the time the 1922-23 trial was being carried out the College herd was included in the Kent Clean Milk competition, in which it was placed second. Whilst the competition was in progress the milk was examined periodically by a dairy expert. Fig. 1 shows the arrangement of the buildings: it will be noticed that the silo is only separated from the cowshed by about 5 yards.

* Hay was valued at £5 per ton, straw at 30s., linseed cake at £14, undecorticated cotton cake at £8 5s. and oats at £10.

The fat content was taken regularly during the two trials described in this paper, and the records do not indicate that the change from roots to silage or vice versa had any definite effect upon the quality of the milk.

A Feeding Trial with Fattening Bullocks.—This trial was commenced on 6th November, 1922, and finished on 8th March, 1923. The silage used was from the 1921-22 crop described above. It came from the upper part of the silo and improved slightly in quality during the trial. Fourteen two-year-old bullocks were available. They were put up to fatten on 26th October in two groups, A and B. The animals in Group A were fed upon a ration containing silage, those in Group B upon a similar ration which contained swedes instead of silage. The beasts were fed in a covered yard in which they lay loose, Group B occupying three small bays and Group A lying in one lot in the large yard. The rations were weighed daily. A preliminary period of 10 days was allowed for beasts to get used to yard feeding, and the trial then started on 6th November.

At the commencement of feeding the rations per head per day were :—

Group A.	*Group B.*
12 lb. Oat straw.	12 lb. Oat straw.
50 „ Silage.	70 „ Swedes.
4 „ Egyptian cotton cake.	4 „ Egyptian cotton cake.
2 „ Linseed cake.	2 „ Linseed cake.
2½ „ Wheat meal.	

The allowance of concentrates for Group A was increased on 14th November by an additional ½ lb. of wheat meal, and on 3rd December 2 lb. of wheat meal were added to both rations. At this date the bullocks getting silage were eating only 7 lb. of straw. On 14th December the allowance of swedes in the ration of Group B was raised to 84 lb. but as the silage had improved in quality the ration of Group A was not increased, the rations from this date to the end of the trial being :—

Group A.	*Group B.*
7 lb. Straw.	12 lb. Straw.
50 „ Silage.	84 „ Swedes.
4 „ Egyptian cotton cake.	4 „ Egyptian cotton cake.
2 „ Linseed cake.	2 „ Linseed cake.
5 „ Meal.*	2 „ Meal.*

The experiment finished on 8th March when there was no noticeable difference in condition between the two groups. The

* Wheat meal until 1st Jan.; after that date barley meal.

average weights of the bullocks were :—

	Average Weight at Start.		Finished Weight.		Gain.	
	cwt.	lb.	cwt.	lb.	cwt.	lb.
Group A	8	18	10	47	2	29
Group B	8	27	10	25	1	110

The average daily gain per head in Group A was 2.1 lb. and in Group B 1.9 lb.

*Costs.**—With silage costing £2 10s. per ton and roots 15s. 8d. the cost of food was £94 9s. 5d. for Group A and £59 16s. 8d. in the case of Group B. The cost per 1 lb. live weight increase was—

1s. 0¾d. in the case of bullocks getting silage, and
9¼d. in the case of those getting roots.

The carcasses were carefully examined, no difference being detected either in appearance, the amount of internal fat, or the flavour of the meat, in the two groups.

Thanks are due to Captain E. T. Halnan and Mr. Arthur Amos for their help in drawing up the scheme of experiments.

Conclusions.—(1) Oat and tare silage has been shown to be a satisfactory substitute for roots in the ration of dairy cows. When silage was used less coarse fodder was required, and in 1922-23 a saving was effected in the concentrates.

(2) In 1921-22 the cost of food required to produce 1 gallon of milk was the same with both the silage and the mangold rations if the latter were not saddled with the loss on the swede crop which failed. In 1922-23 the mangolds were slightly the cheaper food.

(3) In the one trial that was carried out with fattening bullocks silage was found to be a suitable food, but more expensive for fattening than swedes.

(4) The quality of both milk and beef produced by cattle fed upon silage was as good as that produced by root-fed stock.

(5) The great value of silage would appear to lie in the fact that crops suitable for making into silage are much more certain than roots. The silage crop being sown in the autumn or early spring will almost invariably produce something even in districts where roots often fail completely.

* Straw valued at 30s. per ton, undecorticated cotton cake at £8 5s., linseed cake at £14, wheat and barley meal at £12.

(6) Silage is very variable in composition. Rations should therefore be based on an actual analysis.

(7) In a silo 14 feet in diameter and 32 feet high the number of cubic feet to the ton was 55 in 1921 and 53 in 1922.

* * * * * *

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Twelfth Meeting of the Council of Agriculture for England was held on Friday, 22nd February, 1924, at the Middlesex Guildhall, Westminster.

Appointment to Agricultural Advisory Committee for England and Wales.—Before the meeting of the full Council, a meeting of the members thereof representing County and Borough Agricultural Committees was held for the purpose of making an appointment from its number to the Agricultural Advisory Committee in view of the vacancy which existed. The election of Mr. Harry German was moved, seconded and agreed.

Meeting of Council.—The first business of the Council was to elect a Chairman for the year 1924. On the motion of Mr. Ryland, seconded by Mr. Harry German, Mr. George Edwards, M.P., was elected to the Chair. In the course of a short address, Mr. Edwards said he esteemed most highly the honour which had been conferred upon him, and he was sure that all present were anxious to do the very best they could towards putting the industry on a firmer and more prosperous footing than was the case at present.

Death of Council Members.—Lord Bledisloe proposed and Mr. Hamilton seconded a motion recording the deep regret of the Council on learning of the death of their colleague, Mr. Fitzherbert Brockholes. Mr. Robbins proposed a similar vote in respect of the death of the Earl of Jersey, which was seconded by Mr. E. W. Lobjoit. The Council, standing, passed both votes.

Report of Proceedings of Agricultural Advisory Committee.—The Half-Yearly Report (No. 6) was received by the Council on the motion of Mr. E. W. Langford, seconded by Mr. G. G. Rea.

The Minister of Agriculture, the Rt. Hon. Noel Buxton, M.P., in the course of his address, said he appreciated very much the invitation to meet the Council, and he was glad to see the comprehensive agenda for the meeting, which indicated the active part which a large number of members took in the proceedings.

He referred to the situation in regard to foot-and-mouth disease, and said that a Committee to consider the administrative problems in regard to the disease had been set up, with the Rt. Hon. E. G. Pretyman as Chairman, and that another Committee to consider the aspect of scientific research in regard to the disease was about to be set up under the Chairmanship of Sir Charles Sherrington, President of the Royal Society. He said that he sympathised deeply with those who had been placed in an extraordinarily difficult position by the outbreak. The scheme established by the Agricultural Credits Act of last year would be a means of helping those who are in want of capital for re-stocking their farms, in a way that had not been possible before. He had been able to arrange with the Chancellor of the Exchequer for a reduction of 1 per cent. in the rate at which loans could be made, which meant that loans should be available through Agricultural Credit Societies to individual farmers at 5 per cent., instead of 6 per cent. as at the present time. With regard to co-operation, the Chancellor of the Exchequer had agreed to the inclusion in the next year's Estimates of a sum of £200,000 for financing agricultural co-operative enterprises, with a limit for each society of £10,000. He hoped that these facilities would be widely employed. There would be further means provided under the Trade Facilities Act to encourage the formation of larger undertakings of a similar character.

With regard to live stock improvement, he was of opinion that the economy made a few years ago in regard to the grants to Heavy Horse Societies was not a useful one, and he had secured a reversal of the position, so that the grants would be continued in future.

With regard to land drainage work for the relief of unemployment, the grants given by the late Government at the beginning of the autumn would be increased by £60,000, so that schemes which had been held up through lack of funds could now go forward.

In conclusion, the Minister said he hoped that funds would be available to encourage the formation of Account-keeping Societies, somewhat on the lines of Milk Recording Societies, and to provide for the appointment of Marketing Advisory Officers as recommended in the Linlithgow Report. These were some of the ways in which the Government considered it could do good, and be of practical assistance to those engaged in agriculture. He would give the most earnest attention to any suggestions that came from the Council.

Sir Douglas Newton said that the Council appreciated the Minister's action in carrying on the tradition of the past and coming to the Council and stating frankly and fully what was in his mind. He asked as regards the £200,000 for co-operative enterprises whether it would be possible to add to that in the event of more money being required. He expressed the hope that special action would be taken in the development of co-operative marketing and in the grading and packing of fruit. Mr. Nicholls asked whether any special provision had been made in relation to putting the rent of smallholders, ex-Service smallholders, on an economic basis. Lord Bledisloe suggested, in connection with the motion which was on the agenda in the name of Mr. Spraggon as to legislation giving County Councils power to deal with reclamation and improvement of agricultural land, that there was, in his view, a real danger of the Government grant being to some extent wasted unless the County Councils had larger powers than they had at the present time. Mr. Ryland asked whether, with the exception of those matters which the Minister had outlined, the industry was to be left to be carried on on an economic basis, or whether other measures were contemplated. Mr. Dallas asked as to the allocation of the £60,000 for drainage.

The Minister replied that the £60,000 for drainage was in addition to grants already sanctioned, and it would be allocated to schemes deserving of help amongst those which had been turned down or left in abeyance through lack of funds. In regard to the £200,000 for co-operative enterprises, that sum should be sufficient to go on with; he would ask for a further grant if sufficient schemes were forthcoming to justify such a request. There would be opportunities under the Trade Facilities Act for larger undertakings. With regard to Mr. Ryland's question, he would be out of order, he thought, if he entered upon politics at large, and, as to others, he could not go into the subjects which would be raised on the agenda. With regard to all suggestions he would take careful note and consider them. Lord Clinton then moved a hearty vote of thanks to the Minister for his statement. This was seconded and carried unanimously.

Report of the Committee to consider in what manner the work of the Council might be made more profitable in the interests of Agriculture.—As Chairman of the Committee, Lord Clinton proposed the acceptance and adoption of the Report.* He said, in the course of his statement, that when the Selborne

* Printed at page 66.

Reconstruction Committee reported, they had visualised a body which would be of the first importance to the agricultural industry and would be of the greatest assistance to the country and Parliament.

It appeared to the Committee that there were two main reasons why the Council's work had not been more effective, and these were, first, that the number of meetings were insufficient, and secondly, that there was no body, or committee, which could arrange the Council's work and look after procedure. The Act of Parliament laid down certain regulations and provided the Council with a constitution. The main proposals in the Report were that the Council should meet at least four times a year, and that a Standing Committee should be formed with the duties which had been laid down briefly and generally in the Committee's Report. No doubt other duties would be found to come within the Standing Committee's work when it came to function. The Council might pass resolutions with which the Minister himself could not agree, as they might not fit in with the views of the Government. He considered that the Council should be able to present those views to Parliament in other ways than through the Minister, and for that purpose he thought it would probably be eventually necessary to set up a Parliamentary Committee for the purpose so that the Council could, through one or other of its members who are representatives in the Houses of Parliament, be able to put those views directly before Parliament. Mr. Dallas seconded the motion.

Mr. Robbins moved an amendment to Recommendation (A) of the Report, to omit the words "the Council shall meet at least four times a year instead of twice and that." He said that he was in favour of having as many meetings as necessary, but did not see that a good case had been made out for incurring the expense of bringing the Council together without sufficient business to transact. Major Courthope, Mr. Ryland, Mr. Turnor, Mr. Spraggon, Mr. Acland, Mr. Dallas, and other members joined in the discussion, in the course of which it was stated that the months fixed were those in which farmers and others interested could best get away from home, and that a minimum of four meetings a year, with the Standing Committee functioning, could not be excessive. Mr. Robbins' amendment was then put to the meeting and lost, and the Report was adopted by the Council.

Election of Standing Committee.—The question of the method of election of the Standing Committee was discussed, and it was suggested by Mr. White that a small Selection Committee should be appointed to facilitate the election. Mr. Beard seconded the proposal, which, after further discussion, was put to the meeting and lost. The Standing Committee elected were the following:—*Representatives of Land Owners*: The Rt. Hon. F. D. Acland, M.P., Sir Merrik Burrell, Bart., Major Fawkes, Sir Arthur Hazlerigg, Bart., and Sir Douglas Newton, M.P. *Representatives of Farmers*: Mr. R. Bruford, Mr. J. Donaldson, Mr. E. W. Lobjoit, Mr. R. G. Patterson, and Mr. Wm. Knight. *Representatives of Agricultural Workers*: Mr. A. W. Ashby, Mr. George Dallas, Lady Mabel Smith, Mr. R. Walker, and Mr. Denton Woodhead.

Fixing Rents for Small Holdings and Allotments.—Mr. James Hamilton moved:—

> "That this Council recommends that in fixing the rents payable by ex-service men for Small Holdings and Allotments more consideration be given to the recommendations of County Committees."

He said he did so on the assumption that the conditions of smallholders and allotment holders over the country were very much the same as in Lancashire. The Small Holdings Committee of that county had, last October, passed a resolution which pointed out that the depression prevailing in the agricultural industry at the present time was causing great distress, and that the burden carried by smallholders ought not to be aggravated by excessive rents. He said he understood that the Ministry of Agriculture, which had said that it did not consider the rents unduly high, was governed almost entirely by financial considerations, but he thought that the continuance of these men in their holdings was a more important matter than mere finance. Mr. E. W. Langford seconded the motion, which was discussed in the Council by Mr. George Nicholls, Mr. R. L. Walker, Lord Bledisloe, Mr. Royce, M.P., the Minister of Agriculture, Mr. Thomas, and Mr. Spraggon. The motion was then put to the meeting and lost.

Agricultural Workers and the Unemployment Acts.—Mr. Haman Porter moved:—

> "That this Council being aware of the great hardship suffered by the Agricultural Workers of England through unemployment, is of opinion that the Agricultural Workers should be brought within the scope of the Unemployment Acts and respectfully asks His Majesty's Government to take steps immediately to bring the Agricultural Workers of England within the scope of these Acts."

Mr. Beard seconded. Mr. R. B. Walker said that agricultural workers had not been brought under the present Acts because they themselves had decided that they did not desire to come within it, and he suggested that some special scheme be evolved to meet the agricultural workers' case. Mr. Morris, Mr. Spraggon, Mr. W. R. Smith, M.P. (Parliamentary Secretary to the Ministry), Mr. Woodhead, Mr. Acland, Mr. Dallas, Mr. Rea, and Sir Douglas Newton also took part in the discussion. Mr. W. R. Smith said that, in his view, the question must be approached from the standpoint that agriculture does differ from other industries very materially, and that the payment of 10d. a week from the employer for each worker and 9d. from the worker himself as in other industries would probably be an impossible condition. At any rate, the Council might discuss the principle, and, if it endorsed it, leave the matter to the Ministry of Agriculture in conjunction with its advisers to work out a suitable scheme for agriculture. Mr. Ryland pointed out that the wages would have to be put up if the agricultural worker were brought under the Unemployment Insurance Acts with the ordinary contribution, so that, in effect, the whole of the money would really have to come from the farmer. His figures showed that a sum of about £2,350,000 would have to be found, which was unthinkable. Mr. Rea considered that the present unemployment, which was by no means general, had raised this question, but that it was almost entirely due to the present depressed condition of agriculture. That was the condition which should be remedied. If unemployment insurance were carried into effect, more people would be burdened than benefited. In the north of England unanimous opposition would probably be shown by the farm-workers themselves. Sir Douglas Newton suggested that the matter be referred to the Standing Committee for further careful consideration. Mr. Dallas seconded the motion, which was put to the meeting and carried.

Joint Animal Diseases Committee for each County.—Sir Merrik Burrell proposed :—

> "That the Council is of opinion that legislation is urgently needed to provide that there shall be one authority only for the control of animal diseases in each geographical county, which should be a Joint Animal Diseases Committee representing the county and borough councils within the boundaries of each county."

He said that Mr. Pretyman's Committee (in 1922) on foot-and-mouth disease had made strong recommendation for the action he now advocated. It would, however, require more than a

Departmental Order, it would need legislation. There were something like 266 different authorities in the country who can issue regulations regarding animal diseases, and this must lead to confusion. He thought that if the Council expressed a definite opinion on this matter it would strengthen the hands of the Minister of Agriculture in dealing with local opposition to the necessary legislation and also be of assistance to the Committee appointed to consider the administrative problems in regard to foot-and-mouth disease. Mr. German seconded this motion, which was put to the meeting and carried.

Animal Disease Research.—Mr. Dan Crawford moved:—

"That the Ministry be asked how much the Government is at present spending on research for agriculture; also whether they are financially supporting the Rowett Research Institute, Aberdeen, and, if they are not, to propose that the Agricultural Research Council—or such other body as the Ministry think fit—make an inquiry to ascertain whether it would not be desirable for a capital sum and a certain amount per annum to be allocated to this Institute."

He said that he had had an opportunity of visiting the Rowett Research Institution at Aberdeen and had never seen a place of the kind run on more economic lines. He would like to see it fully supported. Mr. E. W. Langford seconded the motion, stating that the work at the Rowett Institution would benefit more than Scotland. He wanted to see a better link between the scientists at the research stations and the farm institutes. It was one thing to test in a laboratory and another to apply the test to animals. Twelve or fifteen cows upon which to carry out experiments were not sufficient. More farm-buildings were required and a dairy of about 60 cows for ration tests, etc. The motion was also supported by Mr. Robbins. Mr. Dallas proposed that the following words should be added to the resolution:—

"That this Council recommends the Ministry of Agriculture, in co-operation with the Board of Agriculture for Scotland, to invite the Directors of the Animal Nutrition Research Institutes of Aberdeen and Cambridge to report upon the further facilities required for the purpose of research on animals in Great Britain, with special reference to the facilities required for large scale experiments."

The addition was agreed to by the mover and seconder.

Sir Daniel Hall, K.C.B. (for the Ministry), said on the subject of research generally that there were three sources from which funds were at present derived: the Ministry's vote, the old Development Fund, and the new Development Fund of £850,000 under the Corn Production Acts (Repeal) Act. These funds provided at present about

£225,000 a year for agricultural research in England and Wales. There was also an expenditure of £264,000 on colleges for education, where a certain amount of investigation and research was being carried on. Scotland was autonomous in this class of research, and was therefore responsible for the State grants expended by the Rowett Institute. Sir Robert Greig had, however, informed him that the total capital expenditure of the Rowett Institute had been £51,000, of which £31,000 had been derived from the Board of Agriculture for Scotland, and that the total expenditure on maintenance up-to-date had been £26,000, all of which but £447 had come from public funds through that Board. As a matter of fact, further capital grants to the Institute were being considered. On the general question raised by Mr. Dallas, he thought that an informal discussion might very well take place between Professors Wood and Orr. Sir Douglas Newton appealed to the mover and seconder of the original resolution to withdraw it, which after further discussion they did on the understanding that Mr. Dallas's proposed addition should stand in its place. This was put to the Council and agreed.

Adequacy of Agricultural Education and Research.—Mr. Dallas moved:—

> "That the Council should appoint a Committee to inquire into the adequacy of the existing facilities for agricultural education and research, and to report upon this matter, dealing at the same time with the allocation of the existing funds between agricultural education, research, and advisory work."

He considered that the Council should have complete knowledge of everything that had been done by way of agricultural education and research and advisory work. Mr. Hawk seconded the proposal, which was supported by Mr. E. W. Langford and Mr. Denton Woodhead. It was agreed by the Council and referred to the Standing Committee for report.

Importation of Potatoes.—Mr. James Hamilton moved:—

> "That in order to stablise the price of potatoes, this Council recommends that in future potatoes shall not be imported except under licence given on the recommendation of the Potato Advisory Committee when in their opinion the wholesale price of home-grown potatoes is such as will cover the cost of production."

Mr. Thomas seconded the motion, which was spoken to by Mr. Gardner, Mr. Dallas, Major Fawkes, and Mr. R. L. Walker. Major Fawkes asked whether the proposal would really stabilise prices at all or protect the public at all. After further discussion, Mr. R. L. Walker moved that the motion be deferred for

further consideration at the next meeting of the Council. This was seconded and agreed.

Adjournment of Council.—Mr. J. Forbes rose to move:—

"That the Council of Agriculture for England is of opinion that in cases where land has been purchased by local authorities for use as allotments, local authorities should not be permitted to sell or otherwise dispose of such land for any other purpose unless and until they have obtained the consent of the Ministry of Agriculture and Fisheries and the Ministry of Health to such sale or disposition."

In the course of Mr. Forbes's speech, Mr. German inquired, on a point of order, whether a quorum of the Council was present. On a count being made, it was found that 41 members only were in the Council Chamber, and the quorum being 47, the Chairman declared the meeting adjourned.

The following is the Report of the Committee (signed on behalf of the Committee by Lord Clinton, Chairman) referred to on page 60 above:—

REPORT OF COMMITTEE APPOINTED 13TH DECEMBER, 1923.

1. A Committee of the Council was appointed at its meeting on the 13th December, 1923, to consider and report in what manner the work of the Council might be made more profitable in the interests of agriculture. The Committee has given careful consideration to this question, and recommend to the Council as follows:—

(A) That the Council shall meet at least four times a year instead of twice, and that special provision be made for calling emergency meetings at short notice.

(B) That a Standing Committee of the Council be set up with constitution, powers and functions as detailed below.

(C) That the Statutory Regulations made by the Minister of Agriculture and Fisheries under Section 5 (1) of the Ministry of Agriculture and Fisheries Act, 1919, should be altered, with the approval of Parliament, and the Standing Orders governing the Council's procedure be amended, to give effect to (*a*) and (*b*), and to make certain minor improvements in procedure.

2. In regard to (*a*), Statutory Regulation No. 3 (1) should be altered as follows so far as the Council of Agriculture for England is concerned—"The Council shall meet in December, March, May and October in each year on such date and at such place as the Minister, after consultation with the Chairman of the Council for the time being, shall direct. The Minister may, by notice in writing to the Secretary of the Council, require an additional or an emergency meeting to be convened whenever he thinks fit, and shall so require an additional or emergency meeting to be convened upon his receiving a request in writing to that effect, signed by the Chairman of the Council, acting with the authority of the Standing Committee of the Council set up under its Standing Orders, or by not less than 25 members of the Council."

3. Regulation 3 (2) should be amended so far as the Council of Agriculture for England is concerned as follows :—"A meeting of the Council shall be convened by a notice in writing sent by the Secretary of the Council to each member of the Council 14 days at least before the date of meeting, but in the case of an emergency meeting for the discussion of a special matter or matters, it will be sufficient if 7 days' notice only be given."

4. In regard to (*b*) of the recommendations above, the Standing Committee should, we think, consist of 16 members, 5 to be owners of agricultural land, 5 to be tenants, and 5 to be representatives of workmen engaged in agriculture. The Chairman of the Council should be an ex-officio member of this Committee. In order to secure closer connection between the Council and the Agricultural Advisory Committee for England and Wales than exists at present, at least one of the five representatives in each of the three groups should also be members of the Agricultural Advisory Committee for England and Wales.

5. Five members of this Committee should form a quorum. The Committee should be elected at the meeting of the Council to be held on the 22nd February next, and re-elected annually at each December meeting of the Council.

6. The Standing Committee should normally meet once a month, with the exception possibly of August, September and January, and at such other times as the Chairman of the Committee may select. The Committee should elect its own Chairman and arrange its own procedure.

7. The duties of the Committee would be :—

(*a*) To keep watch on the agricultural position, and to bring before the Council matters of importance for the purpose of discussion by the Council.

(*b*) To keep in close touch with the Agricultural Advisory Committee for England and Wales, and to ascertain from time to time whether the Minister of Agriculture desires to set down for discussion by the Council one or more subjects on which he wishes to gather the authoritative opinion of agriculturists.

(*c*) To communicate with any state departments, or other bodies representing agricultural or rural interests, including the bodies concerned with research, education and organisation of those interests; and to invite them to submit their policies or other information for consideration by the Council.

(*d*) To prepare the Agenda for meetings of the Council, the items on which should be placed in the following order :—

1. Matters, if any, left over from previous meeting.
2. Statement by the Minister.
3. Reports of action taken by the Ministry of Agriculture in connection with previous resolutions of the Council.
4. Reports of Committees of the Council.
5. Discussions on any subjects suggested by the Minister.
6. Notices of motions from Standing Committee.
7. Notices of motions by members.
8. Any other business.

8. In addition to the suggested connection with the Agricultural Advisory Committee through the Standing Committee it would be of advantage that the

former Committee should present a report to the Council at each ordinary Council Meeting instead of half-yearly as at present.

9. The Secretary of the Council shall act as the Secretary of the Standing Committee, and all resolutions or communications connected with the Committee shall be addressed to him.

10. To give effect to the proposals under (A) above it will be necessary that the Minister of Agriculture be asked to amend the Statutory Regulations under Section 5 (1) of the Ministry of Agriculture and Fisheries Act, 1919, and that the amending Order be laid on the table of both Houses of Parliament.

11. To give effect to the proposals under (B) it will be sufficient if this report is adopted by the Council. It is suggested, however, that the Standing Orders of the Council might be amended in two minor respects as follows:—

(*a*) *Standing Order No.* 3: Amended to substitute "Standing Committee" for "Minister" as the authority to decide the order in which resolutions or motions shall appear on the Agenda.

(*b*) A new Standing Order authorising the Chairman to appoint tellers to assist him in the case of votings or elections by the Council.

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THE GLOUCESTERSHIRE FRUIT AND VEGETABLE CO-OPERATIVE MARKETING SOCIETY.

G. H. HOLLINGWORTH,
Agricultural Organiser for Gloucestershire.

THE idea of the above organisation really started at that period during the war when marketing societies were being formed in various counties for the purpose of disposing of surplus produce grown in gardens and on allotments, thus avoiding waste, and making the most of the food supply. These particular organisations could only be looked upon as war time emergencies, but the promoters of the Gloucestershire Society saw in the movement scope for the improvement of the methods of marketing the fruit and vegetables, eggs and poultry produced for profit in the county. It may be observed in passing that in several of the Western Counties it has long been the custom to sell a large proportion of the locally grown fruit and vegetables at the point of production by means of auction sales, instead of at the point of consumption, as is the case in other parts of the country. Generally, however, the market is controlled by some corporation or private auctioneer, and the well-known market at Pershore in Worcestershire was the first serious attempt at co-operation.

It so happened that at the time the Gloucestershire Society was formed the fruit growers and market gardeners in the Chelten-

ham district, where both fine fruit and high-class vegetables are grown, were dissatisfied with their local market, and much of the produce instead of passing through the market was sent away to be sold on commission. It took some time to persuade the Cheltenham Corporation that it would be better for the local industry and incidentally, the ratepayers, to make a change, but this was at last effected and the Society, which was duly registered as a co-operative society, issued its prospectus on 17th July, 1919. In response to the appeal for capital nearly £5,000 was subscribed in £1 shares, largely by market growers, and a portion by county people who were interested in the movement. The Committee of Management were fortunate at the outset in securing the services of a thoroughly capable auctioneer, who with a manager and necessary staff is wholly employed in the business of the Society. That the movement was justified is proved by the fact that the gross turnover for the first six months trading in the Cheltenham Market was £38,954, or £20,000 more than the previous highest recorded annual turnover of the market.

Benefits of Co-operative Marketing.—It may be well to digress here and point to a few of the advantages to be derived through co-operative marketing. In the first place the market belongs to the producers who are shareholders, though non-shareholders also get the benefit of it, and is controlled by a committee of management representing the shareholders and appointed by them.

The produce is sold at the point of production, the grower sees it sold and is able to judge for himself whether the best is made of it. In short, he gets market price, be it bad, good or indifferent, according to supply and demand. The profits, if any, from the market do not go into the pocket of any outside person, but into that of the grower if he is a shareholder, in the form of interest on the capital he has subscribed and a bonus if the profits on the year's working justify this.

Above all there is the advantage of having a market close at hand in which the grower can dispose of his produce without any financial risk, because it should be understood that the grower always gets the money that his produce realises, less the commission for selling, and the Society takes the risk, which is by no means a small one, of doubtful buyers and bad debts. Indeed, all that is wanted to make a co-operative market a success is a spirit of true co-operation amongst the producers, a realisation that the market belongs to them individually and

collectively, and that it will stand or fall in accordance with the loyalty displayed by those who secure the advantages it offers. The problem of securing this true loyalty is one of the difficulties which promoters of co-operation have not yet been able fully to overcome, and the Society under notice is no exception to the rule.

Further Developments—Grange Court Market.—While the Cheltenham Market was growing in importance the eyes of the Management Committee of the Gloucestershire Society fell on another district, in the Vale of Severn, adjoining the Forest of Dean, which is singularly favoured by nature for growing fruit. This is the home of the Blaisdon Red Plum, a local variety which originated in the village which bears its name. Other good plums are produced in the locality, as well as apples, mostly grown by farmers and small occupiers whose only means of disposing of their fruit was to cart it a long way to a market, send it away on commission, or sell it to a local dealer.

Why not have a market in the heart of this favoured district? The idea was suggested to a few of the more enterprising of the local farmers, who immediately fell in with it. Further capital was raised and a market was opened at Grange Court, close to a junction on the Great Western Railway, on 30th July, 1920. It was a modest beginning—first a sale of fruit in an inn yard—but from the time of opening to the end of the year the turnover amounted to £11,308. Encouraged by the results of the effort land was acquired the following year, three large flight sheds were purchased from a disused aerodrome, and the turnover for the year ending 31st January, 1922, rose to £22,567. What the Grange Court Market must mean to the district is shown by the string of vehicles to be seen outside on any market day in the season bringing the fruit in, the big motor lorries from the mining centres in South Wales taking it away, and vehicles making frequent journeys with it to the station close at hand. There is no township or village even at Grange Court, but only a railway station and an inn, and the market is an excellent illustration of selling produce actually at the point of production.

The executive business of the Society is conducted by the Committee of Management, of which Mr. Bruce Swanwick has been Chairman since the commencement, and at Cheltenham and Grange Court there are Markets Committees to manage local affairs with representation on the Committee of Management. The latest venture was the opening in 1922 of a local market

at Berkeley, mostly for the sale of apples, and as yet this effort is in its infancy. There is no reason why it should not develop, however, because the far-famed Berkeley Vale is a land of orchards, and apples do well there.

Non-Returnable Packages.—Amongst the markets in the western counties those controlled by the Gloucestershire Society can claim to be the pioneers in the use of non-returnable packages for the conveyance of fruit from the market to its destination. In this part of the country the square wicker pot hamper, holding about 56 lb. of apples, 72 lb. of plums, or the same weight of pears, has been an institution ever since markets were established, and only those who control markets know what a responsibility these pots are, how great is the depreciation for losses and wear and tear, and the amount of capital that is required to maintain a supply. To buyers the paying of deposits and the returning of pots is a source of continual anxiety, while no railway company ever appears to have realised the fact that it is as important to convey empty pots back to a market as it is to get full receptacles to their destination. Further, it cannot be claimed that the pot hamper is a good package for fruit. It is too big for ripe plums and the rough ends of willow sticks are not good for either apples or pears.

The Gloucestershire Society therefore decided to go in for non-returnables, a small light receptacle for plums and choice apples and pears, and a bigger package to take the place of the pot hamper. It was a bold step, as the west-country grower is not quickly converted either to new ideas or to new packages, and some have been loath to part with the time-honoured pot. Buyers, on the other hand, have welcomed the idea, and they prefer as a rule to pay their share of the cost of the package and be relieved of further responsibility. In addition to this the Society has had to experiment, and the Committee do not claim now that they have got an ideal package. They have had to educate makers of non-returnable receptacles in the matter of turning out something that is light, cheap and durable, and the mistakes have been made that are inevitable in such circumstances. Nevertheless, the Society has reason to be encouraged by the results of the step it took, and just as the overseas grower has always sold his fruit in non-returnable packages, it looks as if home producers will also follow in line.

The Grower's Number Scheme.—Topping always has been and still is the bugbear in fruit and vegetable auction markets, and the result of it is that growers as a whole get a reputation

for unfair dealing, while buyers lose their confidence in the growers and in the market in which the produce is sold, and when their suspicions are aroused they bid less for the produce so as to protect themselves against it being topped. In short, topping is bad policy, apart from the dishonesty of it, because it must eventually tell against the grower, and in a market where it is prevalent the honest packer does not get credit for his honesty, nor the reward that honesty is supposed to bring.

The Gloucestershire Society has adopted a novel idea for dealing with the topping evil, winning the confidence of buyers and protecting the honest packer. It is called the Grower's Number Scheme and under it a grower can make application for a "Registered Grower's Number" accompanied by a declaration signed by the applicant that in the packing of all fruit, tomatoes, cucumbers, vegetables and cut flowers sent for sale under such number the bulk fairly corresponds with the top layer of each of the packages in the consignment. As far as possible a special part of the market is set aside for produce to be sold under "Registered Grower's Number," and an examining committee, consisting of two buyers and two growers with an independent chairman, is appointed in each market with power to examine any package and suspend any grower under a registered number who has failed to comply with the rules. There are various penalties and other conditions, but enough has been said to show that the Society is at least progressive in its aims. The number scheme has not been in operation long, but it can safely be said that it has great possibilities, and is a commendable attempt to do away with the grave reflection that is cast on home-grown produce.

Amongst its other activities the Society has periodical market shows at which prizes are given for packed fruit, and it is always open to receive suggestions from any of its members for improvements.

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EGG-LAYING TRIALS IN GLOUCESTERSHIRE.

H. S. WRIGHT,

Hon. Secretary, Gloucestershire Laying Test Society.

AMONGST the food producers of this country it is probably true that there are none at the present moment more scientific than poultry keepers; and it is largely the desire to obtain exact knowledge on the subject of egg production that has led to the establishment of laying tests in various counties. Gloucester-

shire is no exception to the rule, for in this county instruction in the scientific methods of poultry keeping has been given for years past under the auspices of the Agricultural Education Sub-Committee. In addition to this the stock of small poultry keepers has been improved considerably through the egg and chick distribution scheme of the Ministry of Agriculture. There was little trap-nesting done, however, before the appointment of the present instructor in poultry keeping, and few of the poultry keepers in the county had exact knowledge as to the laying capacity of individual members of their flocks.

Suggestions that Gloucestershire should have a laying test of its own took concrete form at a meeting called at the Shire Hall, Gloucester, in November, 1921, by the Agricultural Organiser. The meeting was representative of the poultry-keeping interests in the county, and not only was assent given to the proposal, but it was made possible by the financial support promised by those present.

From the day of the inaugural meeting, when the Gloucestershire Laying Test Society was formed, the movement has never looked back. It has the distinction of belonging to the poultry keepers who established it, but such an example of self help in a venture that was essentially educational could not fail to enlist the sympathy of the County Agricultural Education Sub-Committee, and this was shown in a practical manner after the test was started, by a grant towards establishment expenses. The credit, however, for forming the society and starting the test belongs to Gloucestershire poultry keepers, and the subscribers feel—quite rightly—that it is something which belongs to them; consequently they display a greater interest in it than they might have done if it had been established in any other way. The society considers itself fortunate in having Lord Bledisloe as its President and Mr. R. A. Johnson as Chairman of the Committee. Rules provide for a President, Patrons, Hon. Treasurer, Hon. Secretary and Members, with headquarters at the Shire Hall, Gloucester. The society has the assistance of the agricultural organiser, and of the county poultry-keeping instructor, who is responsible for the supervision of the test arrangements. The society is open to members only on the payment of a minimum subscription of one guinea, which is not repeated, and it is hoped that, if and when the society becomes self-supporting, these subscriptions, or part of them, will be repaid at the discretion of the committee, pro rata to the amount subscribed.

Following the formation of the committee and the framing of rules, the actual business of the test was taken in hand, and the offer of Messrs. A. M. & R. A. Johnson to place a portion of their farm at Chalford at the disposal of the society for holding the test was gladly accepted. Messrs. Johnson undertook the management, with the help of the poultry instructor. The test ground is in an exposed position on the Cotswold Hills, 600 ft. above sea level, so that the birds have none of the advantages that a situation more sheltered might afford.

The test, which in the first year was confined to Gloucestershire, is divided into two sections—(*a*) open to any poultry keepers, and (*b*) confined to owners of not more than 50 laying head—each section being sub-divided into heavy and light breeds respectively.

Each house is divided into two pens with a floor space of about 4 square feet per bird, fitted with three trap-nests and a grass run of 120 square yards, an average of 24 square yards per bird.

A ready response was made by poultry keepers in the county to the invitation of the Committee to enter their birds, and all the available pens were taken when the test commenced on 7th October, 1922. The birds were delivered to the ground one week before the commencement of the test, and each bird was examined by the poultry instructor before being passed as sound. After the week of so-called probation, Messrs. Johnson took over the birds, and the individual recording of the eggs commenced.

The test ground, overlooking the beautiful Stroud Valley, presents a picture that could hardly fail to appeal to any poultry enthusiast, as the 52 pens, obviously erected with a due regard to efficiency and economy, with the wired runs attached, give the whole a neat and business-like appearance.

The duties of feeding, re-setting the trap-nests and collecting the eggs take up the time of one man; the eggs are carried into the bungalow-office, where they are weighed separately and points are given to the competitor concerned according to their weight. The method of scoring is as follows:— The test of 48 weeks is divided into 3 periods, consisting of 12, 24 and 12 weeks respectively, as is shown in the following summary:—

	First 12 weeks.	*Next 24 weeks.*	*Last 12 weeks.*
1st grade eggs weigh	$1\frac{7}{8}$ oz. or over.	2 oz. or over.	2 oz. or over.
Score ...	5	4	5
2nd grade eggs weigh	$1\frac{5}{8}$ oz. but under $1\frac{7}{8}$ oz.	$1\frac{3}{4}$ oz. but under 2 oz.	$1\frac{3}{4}$ oz. but under 2 oz.
Score ...	4	3	3

Thus, during the first twelve weeks 5 points are given for each first-grade egg and 4 points for each second-grade egg. During the next 24 weeks, when eggs are plentiful, the standard of weight per egg to be reached is raised and only 4 points are given for a first-grade and 3 points for a second-grade egg.

Third-grade eggs are recorded, but no points awarded.

In the first year's test there were 52 pens, with 260 birds, divided into: Section A—Light Breed, 26 pens; Section A—Heavy Breed, 20 pens; and Section B—Light Breed, 6 pens. The mortality, in spite of the exposure and elevation of the ground, was less than 1 per cent., which reflects great credit on the general management of the test. The total number of eggs collected from the 260 birds competing was 50,978, giving the high average of 196 per bird. The leading pens of heavy and light breeds averaged 240.4 and 240.6 eggs per bird respectively, while the highest individual bird (White Wyandotte) laid 301 eggs during the 48 weeks. No doubt the fact of the test commencing early and the stock sent in by breeders being especially good, had a great effect in obtaining these results.

The first Annual General Meeting of the Society was held at the Shire Hall, Gloucester, on 8th December, when challenge cups and trophies given by various donors, and the Society's gold, silver and bronze medals, and certificates of merit were presented to the successful competitors by Lady Bledisloe.

There is also an open county section for ducks, and the first year saw an entry of 11 pens (4 birds in a pen), the recording of which commenced on 3rd November, 1922. In this section the leading pen averaged 175.5 eggs per duck for the 48 weeks. The ducks are housed separately and run in flock.

Prompt reports are issued to all the leading poultry and county papers and also to each competitor, and the closest co-operation exists between the society and the press.

The members of the society and the committee are to be congratulated on the results of the first year's work, and the test has done good in indicating the laying capacity of the birds of different breeds kept in the county. For the second year a single-bird test, open to the counties of Hereford, Somerset, Wilts and Worcester, as well as Gloucester, has been arranged, and 56 pens (pullets 44, and ducks 12) are now competing, as well as 52 pens containing 5 birds each. The county duck pens have been increased to 14.

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APRIL ON THE FARM.

J. R. BOND, M.Sc.,
Agricultural Organiser for Derbyshire.

Weather Notes.—People usually associate the idea of April with showery weather, yet this month has normally the lowest rainfall of all the twelve in most parts of Britain. Generally it is a period in which the land dries considerably and in which showers assist rather than hinder the work of producing a tilth. Sometimes, however, a wet April followed by a dry warm May so disorganises the work on heavy land, which gets baked, as to prevent the sowing of fields intended for mangolds and swedes and thus increases the area of common turnips and bare fallow. The temperature of the air rises appreciably in April, and with the extended duration of daylight and bright sunshine, outdoor vegetation begins to come into active growth.

Soil Moisture.—Autumn- and winter-sown cereals, being well rooted and established before the return of drying weather, are usually well able to endure a dry growing season: indeed they yield best in warm dry seasons. Spring-sown cereals, however, grow short and yield light if the season has been dry and the moisture reserves in the soil have not been well husbanded. Of the "green" crops, potatoes, kohl rabi and sugar beet, all being deep rooted, can endure drought—provided that the soil is not poor and has been properly worked to the depth necessary for their full root development. Mangolds are intermediate in character, capable of moderate yields under dry conditions but producing the heaviest crops on land furnishing a liberal and regular supply of soil moisture. Swedes and turnips are very dependent on sufficient moisture.

In the case of corn crops, moisture may be conserved by maintaining a loose surface on the soil until the crop covers the ground. Considerable loss of moisture may occur if the soil is left too fine and firm on the surface after sowing: where practicable the harrow rather than the roller should be the last implement used on spring corn. Even after inter-seeding with grass and clover seeds, it is better to finish with the harrow rather than the roller.

In the spring preparation of clean land for roots, moisture is conserved by avoiding undue exposure of the undersoil to the air and sun, and by carrying out the necessary tillage operations in a manner likely to restrain the tendency of the soil to form hard clods. As soon as the land is dry enough for preliminary

surface tillage, it may be lightly harrowed to form a surface mulch, under which the soil will steadily come into condition for further working. In the subsequent operations, clod formation is avoided by not working too deeply at first but by attaining the requisite depth in successive stages. As a rule deep ploughing should be avoided at this time of the year. Where the eradication of weeds is of greater importance than the conservation of moisture for the green crop, the above methods may have to be departed from.

Mangold Sowing.—It is well known that mangolds yield best when an early plant has been secured; and it is recognised good practice in most districts to try to have the mangold land ready and drilled in April. The earliness of the plant, however, is not determined wholly by the time of sowing; mangold seeds do not begin to grow until the soil attains a mean temperature of about 48° F.; and it may be the end of April or the first week in May (depending on soil, situation, district and season) before the soil temperature attains this figure. The best "plant" is secured when the seed comes away soon after sowing; hence it is not uncommon experience for the crops drilled at the end of April to germinate better than the earlier sowings.

Mangold seeds also require shallow covering (about 1 in.) and a well-settled seed-bed. Where possible the ridges should be drawn out (preferably east-west) and left to settle and warm up a few weeks before drilling. Just before sowing the ridges should be chain-harrowed lengthwise to kill annual weeds, to crumble or remove clods and to freshen the soil for the reception of the seed; the ridges should not be made up again at this stage. Where it is necessary to drill on recently-formed ridges, and especially when the tilth is rather coarse, the ridge-roller should precede the drill; otherwise much of the seed may trickle down too deeply into the ridge and the top soil may be too loose and dry for regular germination.

It is advisable to sow plenty of seed, observation showing that the seedlings come up either thickly or hardly at all. The quantity of seed necessary varies from 8 to 12 lb. according to the closeness of the drill rows. In selecting varieties the results of local trials should be consulted. Some varieties yield very heavy crops, but the roots are of comparatively poor feeding and keeping quality.

"Seeds."—A good clovery bed of seeds is a valuable asset. Clover hay has been found to give exceptionally good results as part of the ration of sheep or cattle fattening on turnips. The

comparatively high percentages of protein and calcium salts in clover hay also add to its value as winter fodder for young stock and dairy cows. The crop usually yields better than old meadow land, which is apt to cut light when the rainfall has been low in April and May. Moreover, a strong growth of red clover has a beneficial effect on the farm; not only does it add to the supply of nitrogen on the holding, but the abundant leaf and root residues of the crop enrich the soil in organic matter and the strong tap roots open passages down into the subsoil. Certain farmers occupying stiff coal-measures land in East Derbyshire a few years ago tried the omission of the "seeds" crop from one or two rotations, but found the land became almost unworkably wet in consequence.

There are certain drawbacks to the "seeds" crop; it dries the soil to a considerable depth, so that on non-retentive land and in dry localities wheat following this crop may come up weakly, unless the clover has been ploughed down early. The chief drawback, however, is that the red clover plant is liable to failure from so many different causes.

On a farm near Chesterfield the writer recently saw two beds of maiden seeds in adjoining fields; the soil (heavy loam on coal measures), previous crop (oats), seeds mixture, date of sowing and method of covering, were identical; yet one field had a complete failure of the clover, while the other bore a full and strong plant. The latter field had been limed in the autumn of 1921.

On a farm near Derby may be seen a field (keuper marl) in which one-half bears an excellent bed of clover, while from a line in the middle of the field southwards there is scarcely a clover plant (except on the headlands). The only difference in treatment had been the application of 3 tons of lime per acre to the northern portion six years ago. On part of the southern (failed) portion an experiment had been laid out with various kinds of clover—broad red, late-flowering red and alsike—but none of these plants had come well.

The above two cases illustrate the importance of lime to this crop. Lime is only one factor, but it is a potent one; and on fields where clover seeds are apt to "miss" in large patches, shortage of lime may be suspected, and the soil should be tested for "lime requirement."

On another farm in the Repton district last year, part of a field of oats in which "seeds" had been sown was top-dressed with nitrate of lime. When seen by the writer in November last, there was a full, good plant of red clover on the part where the

nitrate of lime had gone, but very little on the untreated part. This land is light hungry loam, deficient in both lime and organic matter.

A fourth case from last year's experience was that of a plant of clover that germinated immediately after sowing and then quickly disappeared. This field—coal measures clay—had been limed in 1921 and the cover crop was wheat, rather high at the time of sowing. Two causes seemed to account for the loss—insufficient covering of the seeds and the presence of large numbers of slugs.

The Aberystwyth experiments, which have been reported upon from time to time by Capt. Williams, appear to have gone far enough to justify the recommendation that grass and clover seeds should be well covered after sowing by seed or chain-harrowing (not by rolling), and the soil should be dry at the time of seeding. Drilling the seeds with the special clover-seed drill, or with an ordinary Suffolk drill minus the lever-weights, gives good results in south Derbyshire. The writer has also seen good takes of clover and grass seeds under spring-corn, where the small seeds had been mixed with the oats or barley and all drilled together. The germinating corn opens the way for the smaller plants, which would otherwise be unable to push through such a depth of soil.

Seeds Mixtures.—Ready mixed seeds may give results equal to those put together by the farmer himself. The advantage of sowing a mixture of known composition, however, lies in the guidance it affords for the making up of suitable and perhaps better combinations in the future. The following mixture is one adopted as a standard for one year's ley in the writer's trials:—

	lb. per acre.	
Perennial rye grass	6	total 22 lb
Italian " "	6	
Cocksfoot	3	
Broad red clover (British) ...	3	
Single-cut cow grass (British) ...	3	
Alsike	1	

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MANURES FOR APRIL.

H. V. GARNER, B.A.,
Rothamsted Experimental Station.

Top-dressing Cereals.—At this time of the year farmers are deciding whether the wheat and oats have come through the winter with enough vigour to make a full crop, or whether a top dressing will be necessary to push on the plant.

yellow starved appearance shown by cereals after a prolonged and wet winter is largely due to lack of available nitrogen, for the nitrates accumulated in autumn are to a large extent washed out of the upper layers of the soil by rain. Fortunately, this loss can be made good by the use of quick-acting nitrogenous fertilisers, and expenditure in this direction is usually well repaid by the increase in crop produced.

The forms in which spring top dressings are most often applied are as follows:—

(1) *Nitrate of Soda.*—Owing to its quick action this fertiliser should only be used as a top dressing. It is immediately available for the plant and is not retained by the soil, consequently it should be applied when fairly rapid growth is possible. Nitrate of soda has a special value for late top dressings; or in cases as of insect attacks, where an immediate response is desired.

(2) *Nitrate of Lime.*—This fertiliser is much the same as nitrate of soda in its effects on the crop. It finds useful application in certain cases where experience shows that nitrate of soda spoils the tilth of heavy land. It is sold in casks in granular form, and a good drying day should be chosen for its application, as under moist conditions nitrate of lime becomes sticky and difficult to handle.

(3) *Sulphate of Ammonia.*—This is the most concentrated and also the cheapest per unit of nitrogen of the common nitrogenous fertilisers. Since it is retained by the soil and has to undergo certain chemical changes before it is in a condition to feed the plant, this manure is somewhat less liable to loss in wet weather than the nitrates. Under the warm conditions of spring its conversion into nitrate is rapid, and the effect of a dressing of sulphate of ammonia can usually be seen in about a fortnight. This fertiliser gives its best results on soils which are supplied with lime. It has no ill effect on the texture of clays.

(4) *Soot.*—The main value of this popular dressing lies in the sulphate of ammonia it contains. The soot from dwelling houses is richer in nitrogen than soot from industrial sources, and an ordinary sample will contain about 4 per cent. of nitrogen. Twenty bushels of soot is approximately equivalent to 1 cwt. of sulphate of ammonia.

The quantity of top dressing to be used will largely depend on the farmer's judgment as to how much the crop can take without "going down." Recent experiments at Rothamsted indicate that, on land in only medium condition, the common

dressing of 1 cwt. per acre of sulphate of ammonia can usually be raised to 2 cwt. with satisfactory results, particularly in the case of a second straw crop. It is also indicated that if for some reason a top dressing has been delayed until late in the season, say till early in May, a fairly heavy dressing of up to 2 cwt. of sulphate of ammonia is proportionately more effective than a light dressing.

Manures for Potatoes.—The potato crop is dependent for its proper growth on a readily available and plentiful supply of plant food, and extensive trials have shown that a well-balanced mixture of artificials, in addition to a moderate dressing of dung, is more effective than a heavy dressing of dung used alone. This is well brought out by the average results of 353 experiments carried out on Irish farms over the seasons 1901 to 1911:—

Treatment per acre.	*Potatoes per acre.* *Tons.*	*Cwt.*
No Manure	4	0
15 tons dung	8	4
20 " "	9	2
15 " " + 1 cwt. sulphate of ammonia... ...	9	8
15 " " + 1 cwt. sulphate of ammonia + 4 cwt. superphosphate	9	19
15 tons dung + 1 cwt. sulphate of ammonia + 4 cwt. superphosphate + 1 cwt. muriate of potash ...	10	17

A second characteristic of the crop is its dependence on a supply of potash in the artificial mixture. The need for potash is greatest on light soils and in the absence of dung, but even on soils of a heavier nature and where dung is used, potash should still be included. The following results were obtained at Rothamsted in 1923, the figures being averages of triplicate plots:—

Treatment.	*Potatoes. Tons per acre.* *With dung.*	*Without dung.*
No artificials	10.5	8.0
Artificials without potash	11.7	9.7
Artificials with sulphate of Potash ...	12.4	12.2

Note.—Artificials with 15 tons of dung were superphosphate 4 cwt.; sulphate of ammonia 1½ cwt.; sulphate of potash 1½ cwt. per acre. Without dung they were 6 cwt., 2 cwt. and 2 cwt. respectively.

Experiments are also in progress on the question of the nitrogen supply to potatoes, and although sulphate of ammonia is seldom given in larger quantities than 1 to 1½ cwt. per acre where dung is used, there is reason to believe that the dressing could often be increased with advantage up to as much as 3 cwt.

per acre. Thus, in 1923, the yield of certain Rothamsted plots dressed with mixtures containing increasing quantities of sulphate of ammonia were:—

Treatment per acre.	*Potatoes. Tons per acre.*
Dung + artificials without nitrogen	12.0
„ + „ with $1\frac{1}{2}$ cwt. sulphate of ammonia ...	13.7
„ + „ with 3 cwt. sulphate of ammonia ...	15.1
„ + „ with $4\frac{1}{2}$ cwt. sulphate of ammonia ...	14.8

Note.—Dung 10 tons; superphosphate 4 cwt.; sulphate of potash $1\frac{1}{2}$ cwt. per acre. The figures are means of duplicate plots.

For ordinary conditions the following dressings per acre may be used:—

a.	*b.*
15 tons dung.	No dung available.
4 cwt. superphosphate.	6 cwt. superphosphate.
$1\frac{1}{2}$ to 2 cwt. sulphate of ammonia.	2-3 cwt. sulphate of ammonia.
1 to $1\frac{1}{2}$ cwt. sulphate of potash.	$1\frac{1}{2}$ to 2 cwt. sulphate of potash.

The artificials should be mixed and applied in the drills in spring. If desired 2 cwt. of superphosphate may be replaced in the mixture by 2 cwt. of steamed bone flour, which would cause the manures to work better in the distributor.

The Need of Lime.—The condition of clover leys in spring will often indicate that the farm is running short of lime, for none of the common crops are so sensitive to soil acidity. If clover looks poor and patchy and the field has been yielding badly in previous crops, it is worth while to have the soil tested for lime. If, as is likely, a marked deficiency is reported, chalking or liming is the only way to recover the productiveness of the land. The commonest substances used to supply the necessary lime are:—

(1) *Burnt Lime.*—This material is supplied in lumps, which have to be slaked to cause them to break down; or as ground lime, which is ready for sowing without further treatment. Two tons per acre is about the smallest dressing which can be uniformly spread by shovels from heaps in the field. Smaller dressings are better applied with a manure distributor.

(2) *Ground Limestone.*—This is finely powdered limestone rock and is applied in a similar manner to ground lime. In making a choice between ground lime and ground limestone it must be borne in mind that 1 ton of ground lime is as effective as about 35 cwt. of ground limestone. Hence, if the former can be obtained at 50s. per ton on the farm, the latter is worth about 29s. per ton on the farm.

(3) *Lump Chalk.*—Farmers in chalk districts can often obtain this material for little more than the cost of carriage. Dressings of 10 to 20 loads per acre may be applied. The chalk is gradually pulverised by the action of frost and cultivation, and the good effects of such a dressing will last for many years.

(4) *Waste Limes.*—These materials from paper mills, gas works, and other industries are often obtainable at what appears to be a very low price. It is advisable before buying to have an analysis made and then to compare the cost of the actual lime in these substances with that of ordinary burnt lime from some local source.

Usual dressings for sour soils are from one to two tons per acre of burnt or ground lime, or its equivalent of ground limestone. If more lime happens to be used than is required to sweeten the soil a reserve is built up which will postpone the necessity of further applications. To prevent the soil from again becoming sour, dressings of ground lime applied with a manure distributor at the rate of about 10 cwt. per acre every four or five years will usually suffice.

Poultry Manure.—The neglect which poultry manure often receives from farmers and small holders is all the more notable in view of the high value put by agriculturists upon organic manures as compared with artificial fertilisers. Only in those cases where the birds are kept more or less permanently on grass or arable land is the manurial value fairly completely realised. The loss occasioned by careless handling of the accumulated manure from roosts and coops is considerable, and may amount to about one-half of the original value.

The quantity of poultry manure made under different conditions has been ascertained,* the most complete figures relating to fowls. Calculated on the basis of 100 head some typical results are approximately as follows:—

100 *Head.*	*Period.*	*Fresh Manure produced.*
Breeding fowls	1 year.	80 cwt.
Chickens (hatching till 13 weeks)...	13 weeks.	9 cwt.
Fattening birds	3 weeks.	5 cwt.

A thousand fowls will produce about 1 cwt. of manure per day in the houses and a similar amount outside. The annual production for England and Wales is estimated to be at least one million tons.

* See this *Journal*, March, 1907.

The composition of poultry manure depends on the type of bird from which it comes, fattening fowls giving a richer dung than those which are laying. The fresh manure is a rich fertiliser compared with farmyard manure; while air-dried poultry manure, though poorer than good guano, has a similar composition to rape cake. The following are typical analyses (figures being percentages):—

	Manure from birds at liberty.		*Manure from fattening birds.*		*Good Farm yard Manure.*	*Rape*
	Fresh.	*Air Dry.*	*Fresh.*	*Air Dry.*	*Cake fed.*	*Cake.*
Moisture ...	59.5	10.0	70.3	15.0	72.6	10.1
Dry Matter ...	40.5	90.0	29.7	85.0	27.4	89.9
Nitrogen ...	1.75	4.00	2.28	6.52	.77	5.3
Phosphoric acid	1.00	2.27	.97	2.77	.39	2.5
Potash ...	.54	1.22	.55	1.57	.60	1.5

Regarded as a fertiliser, fresh poultry manure is richer in nitrogen than it is in phosphates and potash. It contains about $2\frac{1}{2}$ times as much nitrogen and phosphate as an equal weight of farmyard manure, but only about the same amount of potash. The bulk of the nitrogen is present in an easily fermentable form. The manure is therefore quick-acting, and care must be taken in storage or much of the valuable ammonia will be lost. Assuming that only one-half of the total nitrogen has a value equal to that of sulphate of ammonia, and that the remaining half has one-third that value; and calculating phosphate and potash at current unit rates in superphosphate and potash salts, the poorest of the above fresh samples has a manurial value of 22s. per ton, while that of the richest dried sample is 76s. per ton.

Evidence as to the value of poultry manures is provided by some field experiments on grass land carried out in Cornwall over a six-year period. The comparison was between 4 cwt. of poultry manure and a series of nitrogenous manures each providing the same amount of nitrogen as in 1 cwt. of nitrate of soda.

Treatment per acre.			*Hay: Cwt. per acre. Average over six seasons.*
No manure ...		... ...	9
4 cwt. superphosphate		... ...	$15\frac{1}{2}$
,,	,,	+ 1 cwt. nitrate of soda ...	31
,,	,,	+ sulphate of ammonia ...	30
,,	,,	+ dried blood	30
,,	,,	+ fish meal	30
,,	,,	+ guano	31
,,	,,	+ 4 cwt. fowl manure ...	30

Under the above conditions poultry manure was about as effective as one-quarter of its weight of nitrate of soda (or its equivalent in nitrogen), and would therefore be worth about £3 per ton at present prices.

Eight to ten hundredweights per acre of poultry manure constitutes an ordinary dressing, and to apply this amount evenly a fairly good physical condition is necessary, the fresh manure being too sticky and the air-dry manure too lumpy to be easily handled at this rate. The point to aim at in the management of the manure is to dry and pulverise it with as little loss of nitrogen as possible. Peat moss, sawdust, wood ashes, and gypsum are sometimes used for this purpose, but soil is quite effective and has the advantage of being readily available. In dealing with the accumulations of manure in houses and coops a good practice is to make shallow layers of the manure and of dry earth alternately in the proportion of about two parts of manure to one of earth. The heap is kept under cover and turned occasionally till it becomes dry and friable. Another method which favours quicker drying is substantially the same except that each layer of manure covered by earth is kept on a separate tray, the trays being stored in tiers in a shed. The fertiliser balance of poultry manure may be improved by the addition of superphosphate or basic slag and of some source of potash such as wood ashes or kainit. For manure dried as described suitable additions would be :—

Superphosphate or basic slag at 1/5th of the weight of the soil-dried manure.
Kainit or wood ashes at 1/10th " " "

The compound thus obtained could be used at from 15 cwt. to 1 ton per acre as a general manure.

Owing to its rapid evolution of ammonia in the soil, fresh poultry manure may injure the roots of young plants. The remedy is to conserve and balance the nitrogen rather than to ferment it away by turning over the fresh manure with straw and leaves as is sometimes practised.

Unbalanced it is a forcing nitrogenous manure and suitable as a top dressing for green crops; it is also valuable for strawberries, fruit trees and tomatoes. For turnips, grass, and on heavy soils it should be enriched in phosphate; for potatoes, mangolds, and on light soils, addition of potash as well as phosphates is required.

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending March 5th.* Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	13.15	13.12	13.16	17.10
" " Lime (N. 13 per cent.)	...	...	...	12.10	19. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	14. 2*	14. 2*	14. 2*	14 2.*	(N)13. 7
" " " neutral (A. 25¾ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)11. 5
Kainit (Pot. 12½ per cent.)	...	...	...	2. 5	3. 7
" (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.10	3. 7
Sylvinite (Pot. 20 per cent.)	...	...	...	2.15	2. 9
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.)	...	...	...	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7. 7	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	...	...	11.10	11.10	4. 9
Basic Slag (T.P. 35 per cent.)	...	...	...	...	...
" " (T.P. 30 per cent.)	...	...	...	...	..
" " (T.P. 28 per cent.)	...	2. 4§	...	...	...
" " (T.P. 26 per cent.)	2.13§	2. 0§	...	...	...
" " (T.P. 24 per cent.)	2. 9§	1.16§	2. 0§	...	...
" " (T.P. 20 per cent.)	...	...	...	.	...
" " (T.P. 18 per cent.)	2. 3§	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.15	2. 2
" (S.P. 30 per cent.) ...	3.16	3. 7	3. 3§	3. 7	2. 3
Bone Meal (A. 4¼, T.P. 45 per cent.) ...	9.10	8.15	8.17	8. 5	...
Steamed Bone Flour (A. 1. T.P. 60 per cent.)	6.10	6.15†	6. 5	6.10†	...
Fish Guano (A. 9-10, T.P. 16-20 per cent.)...	12.15	...	12.10	...	...
" " (A. 11, T.P. 10 per cent.) ..	...	...	...	13.10	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P. = Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Animal Nutrition Institute, Cambridge University.

The Feeding Value of Spent Hops.—In a previous article in this *Journal** it was stated that "spent hops, apart from a possible medicinal value, are of no value to the stock feeder." A correspondent has written inquiring for the basis of this statement, since spent hops form one of the many substances

* Jan., 1924, p. 960.

used as absorbent materials in molasses feeding stuffs. Spent hops have occasionally been used as a feeding stuff, generally in those countries where, in certain years, owing to bad hay harvests, difficulty is often experienced in obtaining sufficient forage to carry the stock through the year. Dried spent hops, according to Kellner, have the following analysis : Moisture 10.9, crude protein 15.3, ether extract (fat or oil) 6.8, nitrogen-free extract (carbohydrates) 39.6, woody fibre 21.0, ash 6.4. This material contains the following *digestible nutrients* in every 100 lb. : Crude protein 4.7 lb., carbohydrates 19.0 lb., woody fibre 3.6 lb. The starch equivalent per 100 lb. is 28.7. On the starch equivalent basis, every ton of dried spent hops is approximately equal to three-fifths of a ton of dried brewer's grains.

In Scientific Feeding of Domestic Animals, by Martin Klimmer (translated by Fischer), the following observations occur : "Spent hops are also occasionally used as a feeding stuff. When fresh they contain 25 per cent. of dry matter. Their digestibility, however, is low on account of the tannic acid that is present. Their nutritive value corresponds to that of grain straw." On the other hand, hops are said to be wholesome and to stimulate the digestive functions and the appetite.

In this country, spent hops are often used as an organic manure, and form the basis of at least one artificial manure. In view of the above evidence, it is reasonable to assume that as a feeding stuff, *per se*, spent hops are of little value to the stock feeder, and the writer would never personally use this material to replace concentrated feeding stuffs in a ration.

Economy in Feeding.—With the present prices of purchased feeding stuffs compared with the prices realised for the meat produced, many farmers are turning their attention to feeding their stock as far as possible on home-grown products, or on products that can be purchased more cheaply than they can be produced on the farm. It will be noted that fish meal is an expensive feeding stuff at present prices. Beans and peas are comparatively rich in protein, and many farmers are feeding these to their pigs in preference to buying the more expensive protein-rich feeding stuffs. A friend of the writer is at the present time keeping his pigs out at grass and feeding them on beans, crushed oats and mangolds. The brood sows receive a pint of beans thrown out on the grass, and roots are also thrown out in the afternoon. The young pigs are fed on bean meal and crushed oats, and are successfully finished off as London porkers on this diet.

Description.	Price per Qr. s. d.	lbs.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv d.
Wheat, British	—	—	11/3	11 5	0 16	10 9	71·6	2/11	1·56
Barley, British Feeding	—	—	11/-	11 0	0 12	10 8	71	2/11	1·56
„ Canadian No. 4 Western	37/3	400	10/5	10 8	0 12	9 16	71	2/9	1·47
Oats, English, White	—	—	10/8	10 13	0 14	9 19	59·5	3/4	1·78
„ „ Black and Grey	—	—	9/8	9 13	0 14	8 19	59·5	3/	1·61
„ Scotch, White	—	—	11/4	11 7	0 14	10 13	59·5	3/7	1·92
„ Canadian No. 2 Western	28/6	320	10/-	10 0	0 14	9 6	59·5	3/2	1·70
„ „ No. 3 „	27/9	„	9/9	9 15	0 14	9 1	59·5	3/1	1·65
„ Canadian Feed	25/6	„	8/11	8 18	0 14	8 4	59·5	2/9	1·47
„ Argentine	23/0	„	8/1	8 2	0 14	7 8	59·5	2/6	1·34
Maize, Argentine	45/6	480	10/7	10 12	0 13	9 19	81	2/5	1·29
„ South African	46/9	„	10/11	10 18†	0 13	10 5	81	2/6	1·34
Beans, Rangoon	—	—	11/3	11 5†	1 13	9 12	67	2/10	1·52
Peas, Japanese	—	—	23/6	23 10†	1 9	22 1	69	6/5	3·41
Millers' Offals :—									
Bran, British	—	—	—	8 0	1 7	6 13	45	2/11	1·56
„ Broad	—	—	—	8 15	1 7	7 8	45	3/3	1·74
Middlings Fine (Imported)	—	—	—	10 2	1 3	8 19	72	2/6	1·34
„ Coarse (British)	—	—	—	8 17	1 3	7 14	64	2/5	1·29
Meal, Barley	—	—	—	11 7	0 12	10 15	71	3/0	1·61
„ Maize	—	—	—	12 0	0 13	11 7	81	2/10	1·52
„ „ Germ	—	—	—	10 0	0 19	9 1	85·3	2/1	1·12
„ „ Gluten-feed	—	—	—	9 10	1 8	8 2	75·6	2/2	1·16
„ Locust Bean	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
„ Bean	—	—	—	13 5	1 13	11 12	67	3/6	1·87
„ Fish	—	—	—	20 10	4 8	16 2	53	6/1	3·26
Linseed	—	—	—	22 15	1 12	21 3	119	3/7	1·92
„ Cake, English 9% Oil	—	—	—	13 2	1 19	11 3	74	3/-	1·61
Cottonseed Cake, English 5½% Oil	—	—	—	8 2	1 16	6 6	42	3/-	1·61
„ „ Egyptian 5½% Oil	—	—	—	7 17	1 16	6 1	42	2/11	1·56
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 7†	2 16	10 11	71	3/-	1·61
Coconut Cake 6% Oil	—	—	—	10 7	1 11	8 16	73	2/5	1·29
Palm Kernel Cake 6% Oil	—	—	—	8 0†	1 5	6 15	71·3	1/11	1·03
Feeding Treacle	—	—	—	7 0	0 8	6 12	51	2/7	1·38
Brewers' Grains :—									
Dried Ale	—	—	—	8 7	1 5	7 2	49	2/11	1·56
„ Porter	—	—	—	7 17	1 5	6 12	49	2/8	1·43
Wet Ale	—	—	—	1 15	0 9	1 6	15	1/9	0·94
„ Porter	—	—	—	1 10	0 9	1 1	15	1/5	0·76
Malt Culms	—	—	—	8 0	1 15	6 5	43	2/11	1·56

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 13s. 6d.; P_2O_5, 4s. 1d.; K_2O, 2s. 6d.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat - - - - -	1·29	2 5	71·6	8 13	0 16	9 9
Oats - - - - -	1·29	2 5	59·5	7 1	0 14	7 18
Barley - - - - -	1·29	2 5	71·0	8 12	0 12	9 1
Potatoes - - - -	1·29	2 5	18·0	2 3	0 4	2 7
Swedes - - - -	1·29	2 5	7·0	0 17	0 2	0 19
Mangolds - - - -	1·29	2 5	6·0	0 14	0 3	0 17
Good Meadow Hay - -	1·56	2 11	31·0	4 10	0 14	5 4
Good Oat Straw - - -	1·56	2 11	17·0	2 10	0 7	2 17
Good Clover Hay - -	1·56	2 11	32·0	4 13	1 1	5 14
Vetch and Oat Silage - -	1·43	2 8	14·0	1 17	0 7	2 1

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NEW BUILDINGS FOR THE AGRICULTURAL COLLEGES AT LEEDS AND BANGOR.

THE growth of agricultural education in this country which was so seriously checked by the War has received fresh impetus during the past few years. There is a growing demand for further facilities in this direction, and it is worthy of note that two Universities both playing prominent parts in the agricultural life of the country are now engaged on building schemes which should greatly increase their usefulness in the sphere of agricultural education. The Institutions referred to are the University College of North Wales, Bangor, and the University of Leeds, both of which have recently undertaken the provision of new buildings for their agricultural departments.

University College of North Wales, Bangor.—The new buildings for the department of agriculture in the University College of North Wales, Bangor, form the central feature of the new science buildings designed as a part of the memorial to the officers and men of North Wales who fell in the War. The cost of these buildings is being met from the North Wales Heroes Memorial Fund, with a grant of £15,000 from the Development Fund towards the cost of the agricultural department.

At present the agricultural department is housed partly in rooms in the main college buildings, partly in a detached building formerly occupied by the education department, and partly in an army hut fitted up as a temporary laboratory for agricul-

tural chemistry. Apart from the extreme inconvenience of this arrangement, the accommodation is quite inadequate for the needs of a department which is extending rapidly, the number of students taking agricultural courses having considerably increased during the past few years. Amongst other recent developments of the department may be mentioned the appointment of a special advisory staff whose duty it is to devote themselves to the investigation of special local problems that affect agriculture, and to afford expert scientific advice free of charge to farmers in the College area.

The new agricultural building is designed in two blocks. The front block has two storeys and is set apart for administration, agricultural zoology and botany, and the investigation of animal diseases, while the rear block is allotted to agricultural chemistry. The roof of the front block is flat; and will accommodate greenhouses and insect cages, space for which is also provided around the buildings. A central entrance gives access to the ground floor, which is occupied by the administrative offices, library, store rooms, a museum, preparation room and a large lecture room—37 ft. by 26 ft.—in addition to two rooms set apart for work in connection with animal diseases and rooms for the professors and lecturers. From this block two corridors lead to the agricultural chemistry building. This building contains a laboratory, a lecture room, and the necessary preparation and store rooms. The right wing is allocated to research and the left wing to forestry, which, however, is not strictly a part of the agricultural department.

On the first floor of the front block, accommodation is provided for zoology and botany, each subject having a large laboratory with a lecture room, preparation rooms and two research rooms. At the back are a range of rooms devoted to research and plant pathology and a lecturers' room. The veterinary department is also housed in this block.

The main building will be erected in rustic multi-coloured bricks with portland stone dressings in a simple renaissance style. The rear building will be finished externally in white cement and built internally in sand lime bricks unplastered. The foundation stone of the building, which was designed by Mr. Alan E. Munby, M.A., F.R.I.B.A., was laid by H.R.H. the Prince of Wales on 1st November, 1923.

University of Leeds.—The need for a self-contained department for the agricultural side of the University of Leeds has been apparent for many years, and, when the War broke out

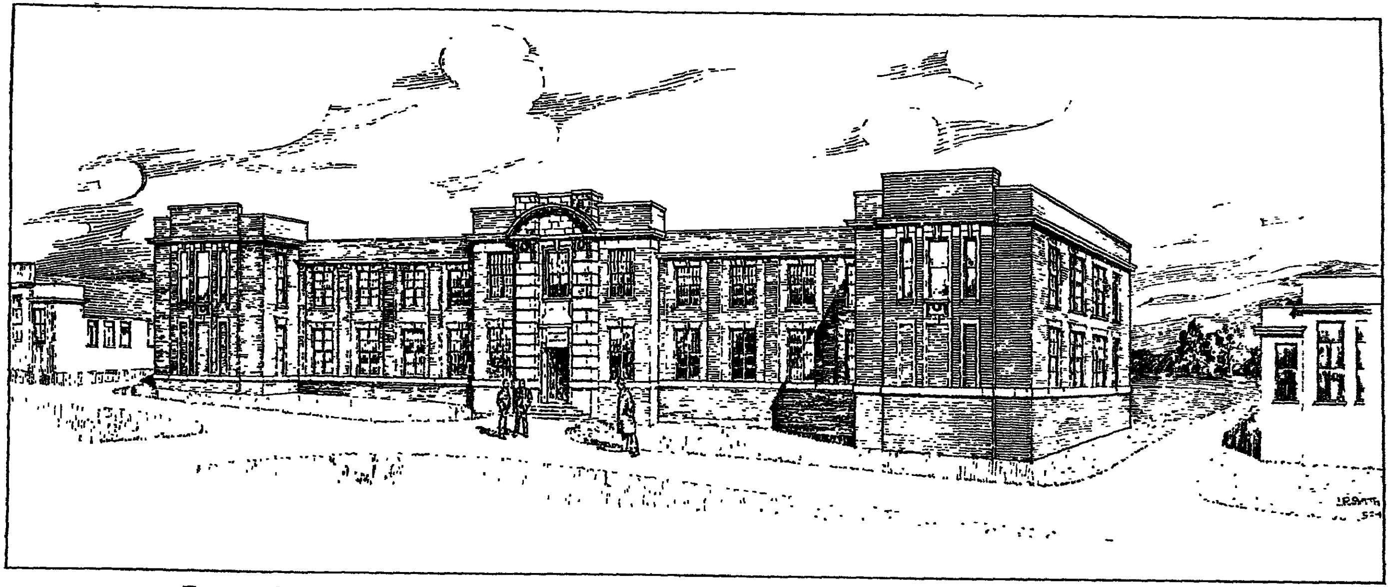

FIG. 1.—New Buildings for the Department of Agriculture, University College of North Wales, Bangor.

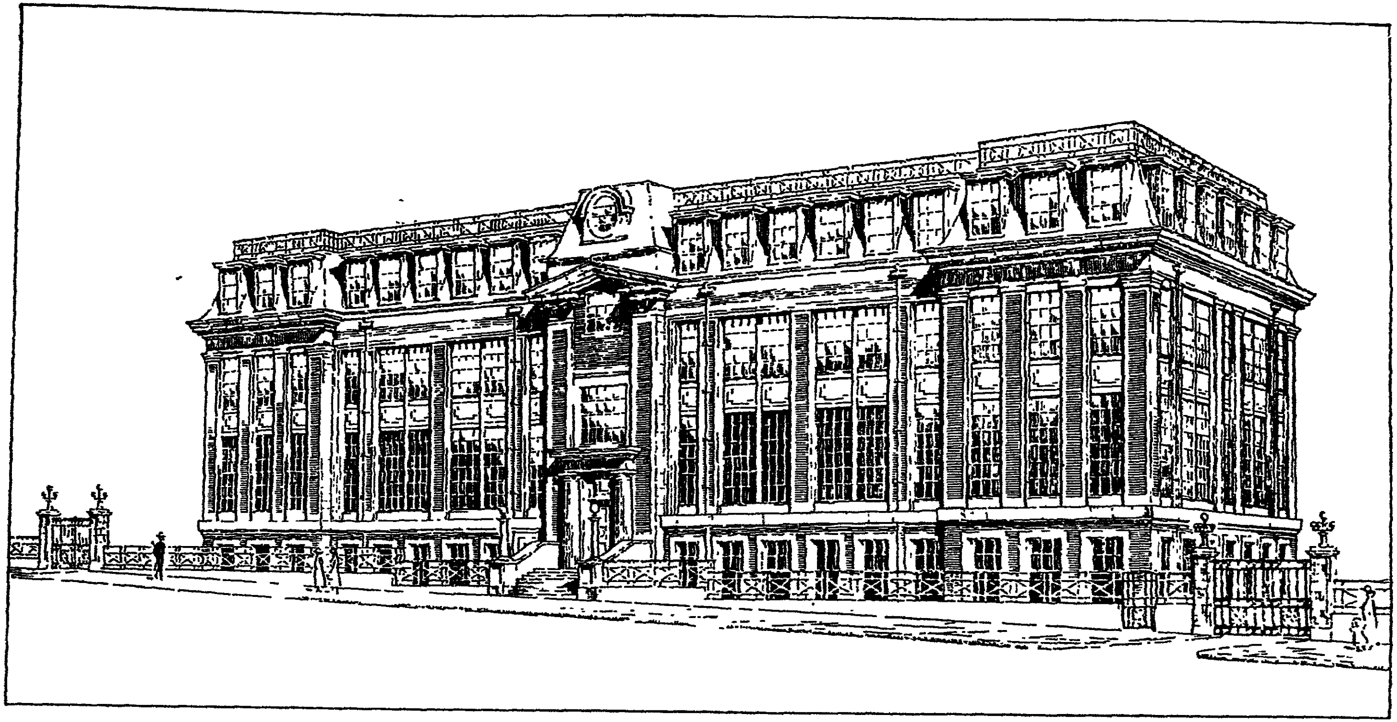

FIG. 2.—New Buildings for the Department of Agriculture, The University, Leeds.

tenders for a new building had actually been accepted. The scheme had then to be set aside, and the department has since had to make shift as best it could, in spite of over-extending work. The administrative offices are in one building, while the teaching is done in three different sub-centres, agricultural chemistry alone occupying a part of the main building of the University which originally sufficed to house the whole agricultural department.

The extension is made possible by generous help received from various sources, now and in years past. Gifts were received from the late Mr. Walter Morrison, the late Mr. Henry Rutson, Major J. W. Dent, and Mr. Emmanuel. The Yorkshire Council of Agricultural Education has made a contribution of approximately £10,000, and £15,000 will be provided from the Development Fund. The University provides the site and the rest of the money required.

The agricultural department is administered by the Yorkshire Council for Agricultural Education which consists of representatives of the County Councils of the three Ridings, Leeds University, and the Ministry of Agriculture and Fisheries.

The department has extended the scope of its work considerably in recent years, particularly in an advisory capacity, and farmers are taking advantage in increasing numbers of the expert advice afforded them in their every-day problems of the soil and methods of cultivation. Farm cost accounting has also become a notable feature of the department's work, giving the farmer a new insight into the business management of his farm and helping him to re-adjust his methods of farming where they have proved uneconomic.

The new building has been allocated to a position on University Road west of the buildings of the textile (clothworkers) group. A good street alignment is here available, and the building will occupy a plot 190 ft. long by 125 ft. deep On the ground floor the largest rooms are a lecture room, measuring 50 ft. by 24 ft., a smaller room measuring 35 ft. by 19 ft. (both of these having the auditorium raised in stages), a museum 50 ft. by 27 ft., a library, secretarial offices and various small professorial or classrooms. The biological department begins on the first floor, where there are a general laboratory and research laboratory, a staged lecture room, research rooms of moderate sizes, a laboratory for advanced work, one or two private rooms and the necessary preparation, sterilising, store and other rooms. On the second floor are a large students'

laboratory, laboratories for chemical nutrition research, balance rooms (for staff and students), large and small lecture rooms and rooms for microscopy and other special purposes. The roof surface is also naturally adapted for outdoor and greenhouse work. The basement, which forms an important part of the accommodation, contains a students' common room, locker room, large machinery room, workshop and store rooms.

The external materials of the building will be stone and brick, but owing to the large window areas these are sparingly used and the structural strength will depend on a framework of steel. Mr. Paul Waterhouse, of London, is the architect, and the foundation stone will be laid on 14th April by Mr. Noel Buxton, Minister of Agriculture and Fisheries.

* * * * * *

Scholarships for Children of Agricultural Workers and Others.

THE Ministry announces that under the scheme for awarding scholarships and maintenance grants for the sons and daughters of agricultural workmen and others a number of scholarships at Universities, Agricultural Colleges and Farm Institutes, are offered for award this year. The scholarships are provided out of the special fund for agricultural development voted by Parliament under Section 3 of the Corn Production Acts (Repeal) Act, 1921, and are confined to (*a*) sons and daughters of agricultural workmen, (*b*) sons and daughters of other rural workers, including bailiffs and small holders, whose financial circumstances are comparable with those of agricultural workmen, and (*c*) *bonâ-fide* workers in agriculture, the financial circumstances of whose parents are comparable with those of agricultural workmen.

The scholarships are of three kinds: Class I, for three or four years, tenable at Oxford, Cambridge, or other Universities which have Departments of Agriculture, enabling the holders to attend degree courses in agriculture or horticulture; Class II, for two years, tenable at University Departments of Agriculture or Agricultural Colleges, for one or other of the diplomas in agriculture, horticulture, dairying or poultry-keeping; and Class III, for short courses (not exceeding one year's duration) in the same subjects, at County Farm Institutes. Provided a sufficient number of suitable applicants is forthcoming, ten scholarships in Class I, ten in Class II, and about one hundred and fifty in Class III will be awarded for courses commencing in the Session starting at Michaelmas next. In each class the

value of the scholarship is such as will enable students to attend the courses in question without any financial outlay on the part of their parents.

Candidates for Class I and Class II scholarships must be at least 17 years of age, and must satisfy the Selection Committee that they have reached a sufficiently high standard of general education to derive full benefit from the course of instruction. In the case of Class I, preference will be given to candidates who have passed an examination which entitles them to enter a University. Candidates for Class III scholarships must be at least 16 years of age, and should possess a useful knowledge of ordinary school subjects. They will be required to produce evidence of their acquaintance with the practical operations of farming (or horticulture, dairying, or poultry-keeping, as the case may be), and, normally, they should have spent at least a year in such practical work.

Forms of application and all other information regarding the Scholarship Scheme may be obtained from the Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, or from the County Authorities for Agricultural Education at the offices of County Councils. Applications should be forwarded to the County Authority for Agricultural Education not later than 30th April, 1924.

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The following note has been contributed by Dr. J. A. Hanley, of Leeds University Department of Agriculture:—

The Use of Precipitated Carbonate of Lime.

Precipitated carbonate of lime is now being advertised by certain firms in the north of England at a price which allows of its delivery in bulk at some stations at a total cost low enough to compete with quick-lime. The material itself is quite suitable for use on the land provided that it arrives in a condition which will allow of satisfactory distribution. The question whether a farmer can use this material instead of ground quick-lime has been asked many times recently. This depends on (1) the relative prices of the two materials; (2) the amount of lime or carbonate of lime to be applied per acre. The precipitated carbonate of lime passes too slowly through the usual mechanical distributor; it is best carted straight on to the field and spread direct from the carts with shovels. Satisfactory distribution can, therefore, only be obtained if the material is used at the rate of at least 2 tons per acre. A dressing at this rate is equivalent to 1 ton of

quick-lime per acre, and if, therefore, a farmer intends to lime land at the rate of 1 ton of quick-lime per acre, he can, where transport does not make too serious an addition to the cost, do it more cheaply by using 2 tons of precipitated carbonate of lime per acre. Where the farmer intends to use lighter dressings of lime, such as the more usual 10 cwt. of quick-lime per acre, it is necessary to distribute the material mechanically, and he is in that case advised to use ground quick-lime.

The farmer should do his best to ensure that the precipitated carbonate of lime is loaded in a condition dry enough to make it spread easily, and he should always have the trucks sheeted. If the weather is wet during transport the material, if not sheeted, may arrive at the farmer's station in the condition of a sludge totally unfit to use until it has been allowed to dry again. One of the great advantages of carbonate of lime is that it can be stored at the farm (preferably under cover) indefinitely without deterioration and used at any time when it is convenient. It can be applied directly to growing crops without fear of injuring them. It does not "set" when wet, but falls again to a fine powder on drying. Like other materials used to supply lime to land, precipitated carbonate of lime should be applied *after* the land has been ploughed, and at a time when it can be thoroughly harrowed in.

The fact that carbonate of lime does not "set" if exposed to wet conditions, whilst still on the surface of the land, makes it preferable to quick-lime for application to permanent or temporary grassland, or in other cases where immediate cultivation is not possible. When comparing prices it should always be remembered that 1 *ton of quick-lime is equivalent to about 2 tons of carbonate of lime.*

* * * * * *

Spraying Machine Demonstration.

THE growing demand from commercial horticulturists for practical assistance and advice during the post-war years has resulted in the appointment of Horticultural Instructors by the Agricultural Education Authorities of nearly all the counties in which horticulture is practised on a commercial sale. A rather striking instance of the useful work carried out by these committees is afforded by the demonstrations of spraying machines which were arranged recently by the Agricultural Education Sub-Committee of the Cambridgeshire Education Committee through its Horticultural Instructor.

Fruit crops in Cambridgeshire suffered very severely last season from the effects of insect and fungus pests. Plums and apples were especially severely attacked, and the crops were reduced almost to vanishing point. Plum trees were attacked by the two common species of aphis and by brown rot in its various forms. Many branches were killed and the dead wood showed innumerable pustules of the brown rot fungus. Apple trees were badly attacked by insects, chiefly the purple aphis. The result of this damage was that the attention of fruit growers was concentrated on the question of spraying their trees, and considerable discussion arose as to the merits and demerits of the various spraying materials and the best methods of their application.

The Committee, through its Horticultural Instructor, took advantage of these discussions and arranged for lectures on the various points and, at the appropriate season, for practical demonstrations in spraying. Mr. Paskett, the Horticultural Instructor, found that many growers particularly wanted advice as to the best machine to purchase, and he accordingly made arrangements with some of the principal firms of manufacturers to carry out demonstrations of their apparatus in the districts of Willingham, Cottenham, and Histon. The members of the West Cambs. Fruit Growers' Association co-operated by lending their fruit plantations, and by providing men and horses for moving the machinery and maintaining an adequate supply of water. Demonstrations were given from 11 a.m. to 3 p.m. on 15th, 16th, and 17th January. Various makes of dry sprayers were demonstrated, in addition to hand wet sprayers and large and small power sprayers. The weather was exceptionally fine for the first two days, and in spite of falling snow on the third day, the total attendance of fruit growers amounted to about 500. In addition parties of boys and girls from village schools attended the demonstrations.

* * * * * *

Farm Wages in Scotland.

FOLLOWING on the last Martinmas Hiring Fairs the Board of Agriculture for Scotland issued a tabular statement of the rates of wages prevailing throughout the country at that time. Particulars of the approximate cash wage and total weekly remuneration of each class of agricultural labour accordingly form a supplement to the Board's Monthly Agricultural Report for the 1st January. The Martinmas Fairs are second in importance only to those

held at Whitsuntide, for whilst many of the married men are engaged at Whitsunday on yearly contracts, the single men more frequently make six-monthly contracts at Whitsuntide and Martinmas.

Married ploughmen form one of the most important classes of Scottish farm workers and, like the single ploughmen and cattlemen, are divided into three grades according to experience and ability, the third grade comprising many youths. In the lower Clyde valley the total weekly remuneration of the first grade ranges from 41s. 6d. to 48s., of which 4s. 6d. to 9s. may be taken as the value of allowances in kind. First grade single ploughmen, on the other hand, range from under 40s. to 48s.; in the case of these workers the entire wage may be paid in cash or, if board and lodging is provided, as much as 25s. may be deducted for allowances. First grade cattlemen receive from 42s. to 52s. and shepherds from 36s. to 42s. per week.

In the eastern industrial area agricultural workers usually receive from 36s. to 49s., of which 11s. to 17s. is paid in the form of allowances in the case of married ploughmen and 12s. 6d. to 18s. in that of single men.

In the south-eastern part of the country married ploughmen receive from 36s. 6d. to 45s. per week, allowances varying in value from 2s. 6d. to 6s. On the other hand, most of the single ploughmen are paid entirely in cash, their wages ranging from 31s. 6d. to 43s. 6d. Cattlemen and shepherds earn from 36s. 6d. to 44s. and from 31s. 6d. to 49s. respectively.

In the north-eastern counties married ploughmen may obtain from 35s. to 40s. per week, of which amounts 11s. may be taken generally as the value of allowances. Single men may get up to the equivalent of 16s. in allowances, their total remuneration averaging from 32s. 6d. to 39s. per week. Cattlemen's wages range from 35s. to 42s. and shepherds 33s. to 48s. 6d.

The Western Highlands include the lowest paid area on the mainland of Scotland—Caithness—where ploughmen get only 28s. 3d. per week. Nearly 13s. of this amount is accounted for by allowances in the case of married men. Cattlemen get little more than ploughmen, but shepherds receive as much as 39s.

Women workers are generally receiving 3s. to 3s. 6d. per day, but in Ross and south-west Perth daily wages range as high as 4s. or 5s.

* * * * * *

National Rat Week, 1923.

IN view of the importance from the national standpoint of destroying rats and the increasing interest shown throughout the country in the subject, the Ministry, in accordance with the practice of past years, organised a special campaign of destruction for one week, the week selected being from 5th to 12th November, 1923.

The number of Local Authorities empowered to execute and enforce the Rats and Mice (Destruction) Act, 1919, had increased from 508 in 1922 to 577 in 1923, owing to the delegation by certain County Councils of their powers and duties under the Act, to minor Local Authorities. All these Authorities were informed by Circular on 12th September, 1923, of the Ministry's scheme, and the Circular embodied suggestions as to suitable lines of action to meet the particular circumstances of each locality. Instructions for making cheap and effective raticides were also sent.

Occupiers of lands and premises infested with rats are not always alive to the responsibility which rests upon them, under the above-mentioned Act, of keeping their lands and premises clear of the pests, and one object of the campaign was to enlighten the public on this point.

As an additional means of arresting public attention, the services of the British Broadcasting Company were enlisted, and a short talk on the general subject of damage done by rats and the need for rat destruction was broadcast by wireless on the evening before the "rat week" commenced, from all the stations of the Company.

The following statement shows the number of Local Authorities to whom the Circular Letter was sent, the number who have replied thereto, and the number who reported that special action had been taken:—

Local Authorities.	*Number.*	*Total replies.*	*Special action indicated.*
County Councils	63	42	28
County Boroughs	82	53	32
Metropolitan Boroughs	28	14	11
Town and Urban District Councils	309	119	72
Rural District Councils	95	38	23
TOTAL ...	577	266	166

In cases where there was no special action, the reasons given were, as a rule, either that the work of rat repression continued throughout the year, or that the district was comparatively free from rats.

The publicity methods generally adopted were :—

(1). Circularisation of occupiers of premises, particularly those liable to infestation owing to the nature of the business carried on :

(2) Public lectures and publication of articles and notices in the local press ; and

(3) Exhibition of placards and posters. At 15 places films and slides, dealing with the subject were exhibited during the week in the local Cinemas.

The following are some of the practical steps reported in connection with the campaign :—

(*a*) Poison was obtained and distributed by 21 Local Authorities, 10 of which made no charge, while the other 11 sold it at cost price. One Local Authority who purchased last year a quantity of steel traps and loaned them as required, purchased a further supply this year, owing to the great demand.

(*b*) Chemists and hardware dealers co-operated with the Local Authorities in 20 places and made a special display of raticides and traps in their shop windows during the week.

(*c*) 63 Local Authorities set a good example by devoting special attention to the rubbish tips, sewage farms, refuse dumps, etc., under their charge.

(*d*) House to house visits were made by Sanitary Inspectors in 20 districts and advice given on the spot.

(*e*) Gassing methods were used in 8 places with the result that large numbers of rats were killed.

It is obviously impossible to estimate the number of rats killed during the week, but it is certain that it amounted to many hundreds of thousands. The "rat week" has undoubtedly been a success also from the point of view of enlightening the public and stimulating their interest in the matter.

A fact of special significance is that so many reports indicate a diminution in the number of rats now seen as compared with a few years ago. This shows that where continuous efforts are made by public bodies and private individuals to overcome the rat problem they meet with considerable success. The want of activity in some parts of the country in administering the Act is to be regretted because it must nullify to some extent the action of those authorities who are alive to the benefits of continuous repression of rats.

* * * * * *

Foot-and-Mouth Disease.—During the five weeks ended 23rd February, 1st, 8th, 15th, and 22nd March the number of outbreaks of foot-and-mouth disease were respectively 79, 100, 62, 60, and 38, the first two weeks representing a temporary, but marked, set-back in the progress recorded in the March issue of the *Journal.*

During the five weeks in question new centres of disease occurred at Keyston (Hunts), Sheffield (Yorks, W.R.), Stopsley (Beds), Benenden (Kent), Doncaster (Yorks, W.R.) (premises previously infected, but freed from restrictions), Burnham (Norfolk), Owston Ferry (Lincs), Quernmoor (Lancs), New Kilpatrick (Dumbarton) (also a recurrence of disease after restocking), Fulbourn (Cambs), Chatham (Kent), Witney (Oxford), Burnley (Lancs), Dereham (Norfolk), Kirkby Malzeard (Yorks, W.R.), Cheriton (Kent), and Winchcombe (Glos) (also a recurrence), and Warmley (near Bristol) Glos.

Several of the new centres mentioned were attributable to the introduction of infection into Northampton, Lancaster, and Banbury markets; the distribution from which was also responsible for numerous other outbreaks.

These incidents necessitated the imposition of restrictions in respect of areas usually of 15 miles radius from the outbreaks, although in some cases this radius had to be exceeded in view of the possibilities arising from market infection. The infected areas in Aberdeenshire, Forfarshire, Perthshire, Fifeshire, Cumberland, and Westmorland have now been released from restrictions, and small rectifications of boundaries have been made in other counties, but although extensive modifications of areas have been contemplated, the reappearance of disease before such Orders could become operative has necessitated the reimposition of restrictions, so that during the period under review no really effective reduction of the extent of areas has been possible. The outbreak near Bristol necessitated the closing of the Bristol Landing Place for Canadian and Irish animals.

The following table shows the details in respect of the period 27th August, 1923—23rd March, 1924:—

Outbreaks	... ...	2,951
Counties affected: England	... ...	39
Wales	... ...	2
Scotland	... ...	11

Animals slaughtered or authorised to be slaughtered:

Cattle, 99,361.	Pigs, 45,646.
Sheep, 38,717.	Goats, 121.

Estimated gross compensation	... ...	£3,177,000
Estimated receipts for salvage	... ...	£451,800

* * * * * *

Milk Advisory Committee.—The Minister of Health and the Minister of Agriculture and Fisheries have appointed a Joint Committee to advise their Departments on matters concerning the production, handling and distribution of milk and dairy produce, including questions relating to education and research, and any legislation, orders and regulations which may be under consideration. The Committee consists of the Lord Kenyon, K.C.V.O. (Chairman), Mr. T. Baxter, Mr. W. Buckley, Mr. T. J. Goodchild, Mr. J. J. Kearns, Mr. E. W. Langford, Mr. J. H. Maggs, Mr. A. Park, Mr. T J. Roper and Mr. J. L. Shirley.

Mr. V. E. Wilkins, of the Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W., will act as Secretary to the Committee, and all communications relating thereto should be addressed to him.

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REPLIES TO CORRESPONDENTS.

Value of Gypsum.—D. F. asks whether calcium sulphate is of any manurial value and whether it makes heavy land work better.

Reply: Sulphate of lime (gypsum), in common with other forms of lime, would better be described as a soil improver than as a manure. It is not used so much now as formerly for application to the land, owing to the increasing use of superphosphate, which contains a considerable amount of this material.

The Ministry's Leaflet No. 170 refers on page 2 to the efficacy of lime generally in improving the mechanical condition of the soil; and some interesting observations on the effect of gypsum, chiefly on heavy soils, will be found on page 586 of the Victorian (Australia) Journal of Agriculture for October, 1923.

Spartina Grass. C.E. asks for information about Spartina Townsendii or Townsend Cord Grass.

Reply: Spartina Townsendii is dealt with in the following papers:—(1) Kew Bulletin, 1918, p. 26: "Spartina and Coast Erosion"; (2) and (3) Kew Bulletin, 1919, p. 391, and 1922, p. 351; (4) Annals of Applied Biology, vol. VII (1920-21), p. 25: "Spartina Problems," by Professor F. W. Oliver, F.R.S.; (5) and (6) Journal of Ecology, vol X, p. 22 (1922), and vol. XV, p. 102 (1923); (7) "Tidal Lands," by Carey and Oliver (London, Blackie & Son), 1918, 12s. 6d. (pages 176-184). To these may be added Kew Bulletin, 1907, p. 190; Stapf in Gard. Chron., Ser. 3, xliii (1908), p. 33, and in Proceed. Bournemouth Nat. Sc. Soc., V (1914), p. 76; Sherring in Proceed. Bournemouth Nat. Sc. Soc., IV (1913), p. 49; Prof. F. W. Oliver at the British Association, 1919; and Comptes Rendus de l'Acad. des Sciences, Tome 174, No. 16 (April, 1922), p. 1,084. Of the above Nos. (1), (2) and (3) have reference to an attempt, unfortunately not very successful, to colonise Spartina on the coast at Clevedon in Somerset. Here the tide proved eventually too strong. Nos. (5) and (6) are short notes referring to its appearance, believed to be spontaneous, but subsequently ascertained to be artificial, in the Dovey Marshes in the middle of Cardigan Bay. No. (6) is interesting as testifying to the comparatively high powers of resistance of the plant to grazing both by cattle and sheep. The most important paper is that by Professor Oliver (No. 4). This describes the original appearance of the species in 1870 in Southampton Water, and its gradual distribution as far as Pagham to the east and Poole to the west. The question whether it is a hybrid or a distinct species is left open. Its habit and behaviour in Christchurch and Pagham harbours are described. It is noted that it has been planted in the Firth of Forth, Wells (Norfolk) and the Harwich Estuary. At Clevedon and Sheerness it has been planted with the definite object of protecting the coast line from erosion. Its use as a food for stock is referred to and the question of its suitability for paper making is discussed. Artificial propagation is effected by planting roots and not by seed.

Soot.—F. I. writes as follows:—"Recently my house chimneys were swept by a chimney sweep who is an enthusiastic allotment gardener, so I asked his views on the matter. His answers were definite and interesting. Soot from a private house, he said, could be used at once (*a*) as a surface dressing to soil, or (*b*) to dig into the ground; but that about a month should

be allowed to elapse before it could safely be used to sprinkle over young foliage (as a slug deterrent) without scorching. Soot from a factory, he said, was, as a fertiliser, of no value whatever, because the heat in factory chimneys was so great that soot, as it formed, was again re-burned, and that factory chimneys were, so to speak, in a state of being constantly on fire. Consequently soot from factories was not black, but a reddish colour, and without any fertilising property."

Reply: The statement as to the superiority of household soot over industrial is borne out by a note on page 398 of Vol. III. of the Journal of Agricultural Science. This gives the analysis of nine samples, that from a kitchen chimney giving as much as 11 per cent. of nitrogen, that from a tall boiler chimney as low as 0.5 per cent. The other seven samples (household soot) averaged approximately 4 per cent. Flue dust from the Cambridge Rubbish Destructor, it is noted, contained no nitrogen. The reason why household soot is superior to industrial soot is partly explained by your sweep, and the enclosed extract from Sir Daniel Hall's "Fertilisers and Manures," p. 68, should serve to complete the explanation. The advice that soot should, if possible, be stored for some time before use is due to the fact that it may possibly contain ingredients injurious to plant life. As a matter of fact, when used as a soil fertiliser, it does need to have been previously stored; as a top dressing for growing crops it is wiser not to apply it until it has been kept for about a month."

The following was the extract enclosed:—

"Of these waste materials the most generally used is soot; its value, which is due as much to its physical effects upon the soil as to its fertilising constituents, has been known for the last three centuries at least. It has already been pointed out that coal contains one per cent. or more of nitrogen; in a fire some of this is evolved as ammonia when the coal is heated, and if it escapes combustion in the higher levels of the fire it is afterwards partially arrested by the particles of carbon constituting soot, which possess an exceptional power of condensing gases upon their surface. In the main soot is only an impure form of carbon; its fertilising value is due to the small and variable proportion of ammonia it has thus absorbed from the gases in the chimney. The percentage of nitrogen present may be as low as 0.5; in exceptional cases it may rise to 6, 3.2 being the mean of a large number of analyses."

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NOTICES OF BOOKS.

The Poultry-Keepers' Text Book.—(E. T. Brown. London: Ward, Lock & Co., pp. 320, price 6s. net.) Contains in moderately condensed form much desirable information both for students of poultry-keeping and for practical breeders. Poultry-keeping nowadays embraces so many branches of both science and practice that it has become increasingly difficult to deal adequately in a single book with all aspects of the subject. Genetics, biology, chemistry, and veterinary science all have a direct bearing upon poultry-keeping, while on the more practical side many poultry-keepers are brought sooner or later into contact with various problems of an agricultural or horticultural nature, in addition to the many questions of poultry-keeping practice and business.

The chapters dealing with breeding are carefully compiled and are written in clear, simple and concise phraseology, which should prove attractive to those poultry-keepers who, whilst possessing no special knowledge of the technicalities of genetics, are yet anxious to understand what light Mendelism and other experimental work in genetics can throw upon practical problems.

On the more practical side, much useful information is given regarding methods of more or less established practice, and it is pleasing to find that the author realises the necessity for dealing, even briefly, with agricultural and horticultural matters of general importance to poultry-keepers. The chapter on weights and measures, and the comprehensive glossary will save much time for students, whilst the reproduction of the poultry-house plans of the Ministry of Agriculture will, no doubt, be appreciated by those about to erect poultry-houses.

The book is well illustrated and is very readable. Though it cannot claim to be a comprehensive and detailed treatise on the poultry-keeping industry as a whole it should prove a very useful addition to the library of the student in poultry-keeping and of the practical worker.

Die Düngerlehre. (N. Prianischnikow. Berlin: Paul Parey, 1923, pp. VIII, 450, fig. 84. Edited from the 5th Russian edition by M. von Wrangell.) A reviewer in the Wiener Landwirtschaftliche Zeitung makes the appearance of this book a text on which to hang a sermon on the need, agriculturally, for the gift of tongues. The agricultural theory and practice of various countries, is, he complains, too much confined in water-tight compartments. This is perhaps quite true as regards Russia, of whose agricultural science both the Germans and ourselves can do little more than glean rather scant excerpts and abstracts. Both the Vienna reviewer and the German editor—herself not unknown as an authority on soil questions—refer to the somewhat un-German style in which this translation is couched. For the foreign—the un-German—reader this is an unmitigated advantage. This book, happily, still preserves sufficient texture of the rock from whence it was hewn to be easily intelligible west of the Rhine. And what is more it is a most interesting work. It is always good, as the Vienna reviewer suggests, to view scientific problems from the angle of another nation's experiences. The agricultural problems and experiences of Russia naturally differ in detail from those of the rest of the world. Russia is a vast country, lacking the link of communications, and possessing practically unlimited supplies of raw phosphates. Hence the nitrogen question must be solved to a large extent by green manuring, and the native phosphate supply exploited to its fullest capacity. On both these, as on other questions, this book, designed originally by the author as a handbook for his students, contains much of absorbing interest. At the same time it is by no means professorial—it bears the stamp of the student not of the dogmatist, and gives the *cons* as well as the *pros*. It is well provided with illustrations, which make a ready and convincing appeal to the eye. In addition there are interesting chapters on the history of manuring and on the organisation of fertilising experiments. There is a short but useful section on the disposal of city refuse. We, at least those of us who cannot read Russian, are under a debt of gratitude to the German translator and editor for putting us in touch with what is at any rate a fresh exposition of an eternal problem.

Year Book and Annual Report of the Essex County Farmers' Union.—(Chelmsford. Issued by The Society. Price 2s. 6d.) A high standard is set by the Secretary of the Essex Farmers' Union, and the consequence is that this Year Book contains an attractive and valuable series of articles which should interest and help those for whom it is intended, Where so much is good it would be invidious to say that any article is the best, but the reviewer would particularly express his own appreciation of the articles on "Bunted Wheat" by Professor Biffen; "Fallentis Semita Vitae," by Mr. James Tabor; "Lucerne," by Mr. Primrose McConnell; and the two articles on "If I were a Farmer," by Mr. H. J. Skelton and A Doctor. All these offer much food for thought, and this is not to suggest that other articles are lacking in this respect, but we are all affected in different directions. Altogether the Essex Farmers' Union may be congratulated on such a clear token that the farmers of the county—and the Union's officers—are very much alive.

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ADDITIONS TO LIBRARY.

Agriculture, General and Miscellaneous.

American Joint Committee on Horticultural Nomenclature.—Standardized Plant Names. A Catalogue of approved scientific and common names of plants in American commerce. (562 pp.) Salem, Mass., 1923, $5. [58(02).]

Boullanger, E.—Distillerie Agricole et Industrielle, Tome I. 3rd Edition. (460 pp.) Paris: J. B. Baillère et Fils, 1924, 10 fr. [663.1(02.)]

Oregon Agricultural Experiment Station.—Bulletin 199:—Sulfur in Relation to Soil Fertility. (45 pp.) Corvallis, 1923. [63.167.]

Field Crops.

U.S. Department of Agriculture.—Bulletin 1180:—Field Experiments with Atmospheric Nitrogen Fertilizers. (43 pp. and 14 plates.) Washington, 1924. [63.1671.]

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin 133:—Results of Experiments with Cereals, Potatoes, Swedes and Mangolds in Yorkshire, 1923. (13 pp.) Leeds, 1924. [63.31; 63.332; 63.512.]

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin 132:—Varieties Trials of Potatoes in Yorkshire, 1923. (4 pp.) Leeds, 1923. [63.512.]

Australian Institute of Science and Industry.—Bulletin 26:—A Classification and Detailed Description of the More Important Wheats of Australia. (72 pp.) Melbourne, 1923. [63.311.]

U.S. Department of Agriculture.—Department Circular 305:—Electrochemical Treatment of Seed Wheat. (7 pp.) Washington, 1924. [537; 63.1951; 63.311.]

Long, H. C.—Garlic and Smut in Wheat. (18 pp.) Reprint from "Milling," Dec. 22, 1923. [63.311:198; 63.24; 63.259.]

Horticulture and Fruit Growing.

Dyer, B. and *Shrivell, F. W. E.*—The Manuring of Market Garden Crops. New Edition. (148 pp.) London: G. Street & Co., 1924, 1s. [63.51(04).]

Commercial Tomato Culture. By the Lea Valley Correspondent of the "Fruit Grower." (48 pp.) London: Ernest Benn, Ltd., 1924, 2s. 6d. net. [63.513.]

Morris, R. T.—Nut Growing. (245 pp.) New York and London: Macmillan, 1921, 12s. net. [63.41(d).]

Hooper, C. H.—The Value of Hive and Wild Bees in the Production of Fruit. (24 pp.) Wye: Agricultural College, 1924, 6d. [63.41(08).]

Plant Pests and Diseases.

Nebraska Agricultural Experiment Station.—Research Bulletin 25:—A Study of the Environmental Conditions influencing the Development of Stem Rust (*Puccinia graminis tritici*) in the absence of an alternate Host. (52 pp.) Lincoln, 1923. [63.21.]

Live Stock and Feeding Stuffs.

Wood, T. B.—Animal Nutrition. (234 pp.) London: University Tutorial Press, 1924, 4s. 6d. [612.394(02).]

Cooper, W. and Nephews, Ltd.—Os Ovinos de Sangue Puro da Gra Bretanha. (58 pp.) Berkhampsted, 1924. [63.602.]

U.S. Department of Agriculture.—Miscellaneous Circular 12: A Handbook for the Better Feeding of Livestock. (48 pp.) Washington, 1924. [63.6043.]

Michigan Agricultural Experiment Station.—Special Bulletin 120:—The Microscopic Identification and Determination of the Specific Ingredients in Stock Foods. (31 pp.) East Lansing, 1923. [343.53(c); 63.60433.]

Medical Research Council.—Report on the Present State of Knowledge of Accessory Food Factors (Vitamins). 2nd Edition. (171 pp.) London: H.M. Stationery Office, 1924, 4s. 6d. [612.39(02).]

Veterinary Science.

The Veterinary Journal.—Special Foot-and-Mouth Disease Number, March, 1924. London: Baillière, Tindall & Cox, 2s. [619.2(*d*).]

Poultry.

Brown, E. T.—The Poultry-Keeper's Text-Book. (320 pp.) London: Ward, Lock & Co., 1924, 6s. [63.65(02).]

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Economics.

Meakin, W.—Where Farming Pays, and Why. (64 pp.) London: Iliffe & Sons, 1924, 1s. [334(489).]

(A short account of the co-operative organisation of agriculture in Denmark.)

Bogart, E. L.—Economic History of American Agriculture. (183 pp.) New York and London: Longmans, Green & Co., 1923, 6s. [63.73.]

Spencer, A. J.—The Agricultural Holdings Act, 1923, with Explanatory Notes and General Forms. 7th Edition. London: Stevens & Sons, 1924, 10s. 6d. [347(*a*).]

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NOTES FOR THE MONTH.

THE Minister of Agriculture, on 14th April, introduced into Parliament a Bill for the better regualtion of agricultural wages.

The Agricultural Wages (Regulation) Bill.

The Bill was to come up for second reading after the Easter recess. Farmers interested can obtain a copy of the Bill through a bookseller or from H.M. Stationery Office, price 6d. The following is a brief outline of it:—

Provision is made for the establishment of a Wages Committee for each county (or group of counties) and of an Agricultural Wages Board, each comprising representatives of employers and workers in agriculture in equal proportions, with the addition, in the case of the Committees, of an independent Chairman elected by the Committee and, in the case of the Board, of independent members appointed by the Minister. The Chairman of a District Committee will not have the right to vote unless he is so empowered by the Committee.

The County Committees are to be charged with the duty of fixing minimum rates of wages for the various classes of agricultural workers in their areas, but such rates will not become operative unless and until confirmed by the Wages Board. Before any rate is fixed, either by the Board or a Committee, public notice of the rate must be given, and objections may be lodged to it. In the event of a Committee failing to fix minimum rates within two months of its establishment, the Board may request them to fix such rates and, failing compliance with this request, the power of fixing the rates devolves upon the Board, who may also secure the cancellation or revision of any rate previously confirmed by them or the fixing of a minimum rate for any special class of workers.

Minimum rates confirmed by the Board will be legally binding on all employers in agriculture in the areas concerned and will be enforceable, if necessary, by official proceedings on the workers' behalf. The only exceptions to the minimum rates will be those in which the Wages Committees decide to grant permits

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exempting workers from the operation of the rates on account of physical injury or mental deficiency or other infirmity.

The Minister may, in accordance with the provisions of the Bill, make Regulations empowering the Committees and the Board to define the allowances in kind which may be reckoned as part payment of wages and to define the employment which shall be treated as overtime employment for the purpose of the minimum rates.

In the case of workers who are employed on piece work for which no minimum piece rate of wages has been fixed, the Wages Committees may investigate any complaints which are made by the workers and order the payment by the employer of such amount by way of arrears of wages as appears to them to be necessary to bring the worker's earnings up to the level of the minimum wage.

The provisions of the Bill differ from those of the Corn Production Act of 1917 mainly in respect of the functions of the District Committees which, under that Act, had a purely advisory capacity, but are now to be charged with the specific duty of fixing minimum rates of wages for their areas. The constitution of the Committees varies also in so far as the independent members formerly appointed by the Minister on each Committee are replaced by a Chairman elected by the representative members. The provision of the old Act restraining the wage-fixing authority from fixing rates below a specified amount (which for the purpose was 25s.) is omitted from the new Bill, and the Committees are simply enjoined to secure for able-bodied men such wages as are adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the nature of his occupation.

* * * * * *

THE Agricultural Returns Bill which is now before Parliament passed its second reading in the House of Lords on 10th April.

Agricultural Returns Bill.

This Bill is intended to give the Ministry the compulsory powers to require these returns which it had under the Corn Production Act of 1917, but which disappeared when that Act was repealed.

The compulsory powers are needed not because they will be put into force (except in very rare instances) but because they will give the Ministry and in particular the Ministry's local officers the necessary support in collecting particulars from

and to the industry of obtaining information on which opinions can be formed as to the magnitude, progress and productive capacity of the different branches of agriculture.

The value of these returns cannot be questioned. They are the basis of all discussion on agricultural policy, and afford the only reliable evidence of the dimensions of the industry, and of the changes in cultivation and in the numbers of livestock. Information on these points is very essential to any adequate estimate of the economic conditions of agriculture.

While the large majority of farmers fully recognise the value of these returns and endeavour to give complete and accurate information, there are some who are careless and indifferent. In a proportion of cases the return is obtained only after repeated applications and sometimes a visit from the Ministry's Crop Reporter, and in a small minority of cases the occupier declines to make a return.

These cases of failure to furnish the returns promptly add materially to the cost of collection, and delay publication of the results. In this connection, it is of interest to remember that the principle of the Bill has received the support of the principal Agricultural Organisations. At a Conference of the National Farmers' Union of England and Wales, the National Farmers' Union of Scotland, and the Irish Farmers' Union held in April of last year the following resolution, which had been passed by the General Purposes Committee of the first-named union, was endorsed :—

> "That this Council of the National Farmers' Union, recognising the great value of accurate statistical and economic information to the industry in all its branches, informs the Minister of Agriculture that it would welcome the introduction of a measure in Parliament to put upon a sound basis the annual Agricultural Statistics for England and Wales, provided that such a measure contained due guarantee that the information so given by individual farmers would not be disclosed or used for any other purpose than the compilation of these returns."

The Bill includes a clause to meet the point raised in the last clause of this resolution. The proposal to make the returns compulsory has also been submitted to the Agricultural Advisory Committee, the Council of Agriculture, and the Council of Agriculture for Wales.

Reference may be made to one or two points to which exception has been taken, for instance, complaint is sometimes made in

regard to the request included in the return for 1921 and 1923 in respect to the number of workers employed. The only information as to the number of men employed in agriculture apart from this is contained in the Occupation Census, which is only taken every ten years and is issued long after the period to which it refers. The particulars given in the returns are available promptly and provide information on the current position, while they are more valuable in some respects than the Census figures, as they give the number of persons employed as stated by the occupier, whereas the Census figures depend on how the person himself describes his occupation. Information in regard to the number of persons employed is obviously of fundamental importance in any consideration of the economic position of agriculture.

Exception has been taken to the clause which provides that a person who fails to make a return, or who makes a false return, shall be liable to a fine not exceeding twenty pounds. Proceedings under this clause would hardly be instituted except in really flagrant cases, and where a conviction followed, the amount of the fine would be fixed by the Court.

Criticism is sometimes directed against what is called the complexity of the annual return. The return, however, only asks for details which are or should be well within the knowledge of the occupier, such as the area under different crops or the number of live stock on the holding. Apart from this, details are necessary because agriculture is not a single industry but comprises a number of different industries, while agricultural practice varies considerably in different districts. A return in detail is really essential if the interests of all classes of agriculturists are to be fairly considered.

The Ministry moreover is continually being pressed to furnish or to collect statistical information on a number of points in regard to which reliable data are at present lacking. This is particularly the case with regard to fruit and poultry.

In the case of fruit, an attempt was made last year to get information which would enable estimates of fruit production to be made. There is a strong demand for this in the trade, although individual growers in some cases complained of the trouble involved. In the same way, two years ago when poultry statistics were collected some persons regarded it as unnecessary. The National Poultry Council and other poultry interests on the other hand, complain that the information collected in regard to their industry is insufficient.

THE Ministry's annual report on the agricultural production of England and Wales in 1923 has just been published.

Agricultural Production in 1923.

In addition to estimates of the yield of the main crops, figures for which are given by counties, the Report includes, as last year, estimates of the production of early potatoes, carrots, and other minor crops. A new feature is the inclusion of estimates, made by the Ministry's Inspectors and Horticultural Organisers, of the production of the various kinds of fruit. Estimates of the production of meat, milk, butter, cheese, poultry, eggs and wool are also included, so that the Report deals with practically the whole output from the farms of the country.

The approximate value of the products sold off the farms of Great Britain for consumption has again been calculated, and the figures are given separately for each of several main groups of commodities for 1922 and 1923.

In continuation and extension of the information published in 1922 as regards the average characteristics of holdings of different types, two further types of holdings have been added, viz., farms on which potatoes are an important crop, and large arable farms of Norfolk. For ease in comparison the acreage of crops and number of live stock have been calculated per 1,000 acres of crops and grass in each case, and the differences between the general run of arable farms in Norfolk, arable sheep farms, potato farms, mixed farms of various sizes, and grass farms devoted to milk production and sheep respectively are brought out clearly. A table is also given showing the number of regular workers employed per 1,000 acres on each type of farm.

Special returns have been furnished by a number of farmers of the output from their farms. These returns have been tabulated according to the type of farm, and afford interesting data of the average sales from mixed farms of different sizes in the eastern and western half of the country respectively and from potato farms, together with the quantity of milk produced on dairy farms and the quantity of eggs and poultry sold off poultry farms.

The Report, which forms Part II of the Agricultural Statistics, 1923, is published by H.M. Stationery Office and may be purchased through any bookseller, price 1s. 1d., or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 1s. 1½d. post free.

Assistance to Agriculture under the Trade Facilities Acts.

ATTENTION is directed to the possibility of obtaining assistance under the Trade Facilities Acts in respect of large undertakings which it may not be possible to assist under the scheme of loans to agricultural co-operative societies which is administered by the Ministry.

Under the terms of the Trade Facilities Acts the Treasury may guarantee the interest and repayment of loans raised in connection with the carrying out of any capital undertaking, or for the purchase of articles manufactured or produced in the United Kingdom which are required for the purposes of any such undertaking, if they are satisfied that the application of the loan in the manner proposed is calculated to promote employment in the United Kingdom.

Agricultural undertakings which might be eligible for consideration are sugar-beet factories, dairy factories or milk depots, large bacon factories, live stock auction marts, fruit markets or other large-scale undertakings dealing with agricultural produce.

Under the Trade Facilities Acts the Treasury can only guarantee loans; they have no power to make a loan of any kind. The guarantee cannot be used for the provision of working capital, nor for the purpose of extinguishing existing liabilities.

Application should be made to the Trade Facilities Advisory Committee, 16 Finsbury Circus, London, E.C.2, who will have to be satisfied on the following points, among others:—

1. That the undertaking can raise the rest of the money (apart from the guaranteed loans) needed to carry through the scheme to completion and equip it with working capital.
2. That the scheme is well thought out and has good prospects of commercial success.

* * * * * *

The Linlithgow Committee.

IT is announced that the Stationery Office are to publish a cheap edition of the Reports of the Departmental Committee on Distribution and Prices of Agricultural Produce, which sat under the Chairmanship of the Marquess of Linlithgow during the whole of last year. The Committee submitted four interim reports, dealing with Milk and Milk Products, Fruit and Vegetables, Meat, Poultry and Eggs, and Cereals, Flour and Bread, together with a Final Report, and these reports examine in

detail the distributive system in the case of each group of products. The reports are to be issued bound in one volume, at a price of 3s. 6d. net, and are expected to be on sale early in May.

* * * * * *

Destruction of Weeds by Spraying.

EVER since the discovery that Charlock could readily be destroyed in a corn crop by spraying with a solution of copper sulphate—without real injury to the corn—it has been the hope of farmers and research workers that chemical means would be found to enable them to combat other weeds. The Ministry is encouraging research in this direction. A good deal is already known, and in general terms it may be said that it has been found that the spraying of crops with chemical substances, more especially with sulphate of copper (bluestone) and sulphate of iron, is exceedingly useful in destroying weeds. The destruction of Charlock (*Brassica Sinapistrum*, Boiss.) in corn crops by spraying is dealt with in the Ministry's Leaflet No. 63, the first edition of which was issued just over 24 years ago. Solutions of the sulphates of copper and iron, however, may be employed against other weeds, some of which may be destroyed and others crippled. Persicaria or Red-shank (*Polygonum Persicaria*, L.) and Spurrey (*Spergula arvensis*, L.) may be killed by spraying with 4 and 5 per cent. solutions of copper sulphate respectively; while the following weeds are more or less crippled and seeding largely prevented by spraying with a 5 per cent. solution of copper sulphate, or a 15 per cent. solution of sulphate of iron:—

Poppy (*Papaver* sp.).
Corn Cockle (*Agrostemma Githago*, L.).
Black Bindweed (*Polygonum Convolvulus*, L.).
Dock (*Rumex* sp.).
Groundsel (*Senecio vulgaris*, L.).
Dandelion (*Taraxacum officinale*, Wigg).
Perennial Sow Thistle (*Sonchus arvensis*, L.).
Cornflower (*Centaurea cyanus*, L.).
Thistles (*Cnicus* sp.).
Coltsfoot (*Tussilago Farfara*, L.).

Yellow rattle (*Rhinanthus Crista-galli*, L.) may in some cases be materially reduced by dressing the infested meadows with salt at the rate of 5 or 6 cwt. per acre as soon as the seedlings appear in spring, usually about the end of April. In one case 2 cwt. per acre of dusty nitrolim applied in dry weather at the end of May proved effective.

Notes on the destruction of Hoary Pepperwort (*Lepidium Draba*, L.) were given in the April issue of this *Journal* (p. 29).

Spraying with sulphate of ammonia (1 to 2 cwt. in 60 gal. of water per acre) has also been tried. The following plants are said to have yielded to this treatment:—

Corn Buttercup (*Ranunculus arvensis*, L.).	Charlock (*Brassica Sinapistrum*, Boiss.).
Speedwells (*Veronica* sp.).	Wild Radish (*Raphanus Raphanistrum*, L.).

In this connection it is important to bear in mind that most cultivated crops may also be seriously injured by this spray, with the exception of wheat and oats and possibly barley and rye. It should not be sprayed on crops other than cereals, and even then not when "seeds" have been sown with the corn.

The Woburn experiments many years ago showed that the Wild Onion (*Allium vineale*, L.) was largely reduced, without injury to the soil for a subsequent corn crop, by spraying with a 5 per cent. solution of pure carbolic acid.

Among other substances which have been used as weed killers in various ways are arsenic compounds, bisulphate of soda, kainit, sulphuric acid, hydrochloric acid, nitrate of copper, and chlorate of soda.

These brief notes are given for the guidance of those who would like to try spraying this year. All particulars available in connection with any weed or substance mentioned will gladly be sent on application being made to the Ministry.

* * * * * *

Deputation from British Sugar Beet Society.

A DEPUTATION from the British Sugar Beet Society, Limited, was received at the House of Commons on 11th April by Mr. Noel Buxton, the Minister of Agriculture and Fisheries, and Mr. Graham, the Financial Secretary to the Treasury. The deputation stated that in order to preserve the existing factories and to provide new sugar factories, without which the farmer would have no market for his beet, some form of stabilisation to the infant sugar beet industry was essential, and they urged the Government in the interests of British agriculture to consider favourably the following three proposals with a view to maintaining and developing the industry on sound and permanent lines:—

(1) The assistance to the sugar beet industry to be guaranteed by the State for a definite term of years. Such a guarantee would involve the payment of a subsidy to the industry in the event of the import duty in any year being less than the assistance secured under the guarantee.

(2) The Trade Facilities Act Advisory Committee, in the altered situation arising from the foregoing proposal, to be empowered to recommend guaranteed advances to sound beet sugar factory schemes, on such conditions and on such terms of repayment as will not discourage the raising from private sources of the balance of the necessary capital on the security of shares.

(3) A grant to be made from the Development Fund to the Society for the promotion and maintenance of a School for the Sugar Industry, one of the main factors of the success of the Beet Sugar Industry, in Continental countries. Such a school, in conjunction with the Universities and existing factories, would train technical experts and foremen for future factories.

Mr. Buxton in reply said that the representations of the Society would receive the careful consideration of the Government. He could not, however, give a definite reply at the moment as to the Government's intentions as that would be anticipating the Budget statement. He could say, however, that the Government recognised the importance of practical encouragement to any new industry which offered reasonable chances of success, and that they would carefully consider any schemes which were put forward with regard to this particular new industry.

Mr. Graham explained the nature of the regulations of the Trade Facilities Act Advisory Committee, and said that everything would be done to make the conditions as elastic as possible. He also promised to convey to the Chancellor of the Exchequer the points raised by the deputation.

* * * * * *

Electro-Culture Investigations.

THE Electro-Culture Committee recently presented to the Minister of Agriculture its Sixth Interim Report, dealing with its work during 1923.* Previous work of the Committee has been directed chiefly to ascertaining (1) the type of electrical apparatus most suitable for the production of high-tension discharge, (2) the maximum effective strength of current, and (3) the effect of the discharge applied under field experimental conditions to spring-sown cereals. Regarding (3) the Committee have shown that, on the average, an increase of 20 per cent. may be expected when certain spring-sown cereals are subjected to the discharge. It may be recalled that a very striking result was obtained in 1922 from pot-culture experiments, an increase of 118 per cent. in yield of grain being obtained by electrification for the second month of the growing season only, the current

* Copies of this Report can be obtained from the Secretary of the Committee, Mr. W. R. Black, B.Sc., Ministry of Agriculture, 10, Whitehall Place London, S.W.1.

being applied for six hours daily. In view of this result the Committee decided to discontinue, temporarily, its field work, and to concentrate on pot-culture, small-plot, and laboratory work for a time, the object being to ascertain the most suitable periods and hours of the day for the discharge. In 1923, therefore, pot experiments were carried out at Rothamsted, small-plot experiments at Rothamsted and Lincluden (Dumfries), and laboratory work at the Imperial College of Science and Technology.

In the pot experiments at Rothamsted in 1923 the best results were given by electrification during the second month only, and in this case electrification for six hours daily was more effective than electrification for one hour daily. This result confirmed that obtained in the pot-culture experiments in 1922, but the increased dry weight of grain in 1923, viz., 24 per cent., was not nearly so marked as that in 1922, viz., 118 per cent.

In the small-plot experiments in 1923 at Lincluden electrification for one month only gave better results than electrification for the whole three months of the growing season, there being little to choose between the individual months in this respect. The small-plot experiments at Rothamsted had to be given up, as the crop failed owing to the selection of new ground and to the abnormal season.

The general results from the pot-culture and small-plot experiments of 1923 confirm, therefore, the results of the pot-culture experiments in 1922, viz., that electrification of spring-sown cereals for one month is more effective than electrification for three months; and there is some evidence to show that electrification for the second month of the growing season is most effective. In the second month's electrification the effect of the discharge seems to be a differential one, affecting grain weight rather than the total weight of plants.

The laboratory experiments have been concerned with the after-effect of the current. The after-effect from one hour's discharge has been found to be greater than that of three hours' discharge, and the after-effect from half-an-hour's discharge has been found to continue for nine hours.

Work has also been carried out on the effect of ordinary atmospheric electricity. The results obtained so far give some indication of a beneficial effect on plant growth of atmospheric electricity.

In the present year the Committee is confining its programme to pot-culture, small-plot, and laboratory work, as in 1923, but

additional investigations will deal with the effect of the discharge over smaller periods than one month, and the effect of varying the effect of the current, since no knowledge is yet available of the minimum strength of current that is effective. In 1925 the Committee hopes to resume field work, in order to test, on various soils and under different climatic conditions, the results obtained from the pot-culture and small-plot experiments in 1922-23-24.

* * * * * *

The Agricultural Index Number.

FOR the first time since October last year, the index number of prices of agricultural produce shows a decline, the general level of prices during March being 57 per cent. above that in the corresponding month of the years 1911 to 1913, as compared with 61 in February. A fall of 4 points between February and March also occurred last year and, on the average, prices in 1924 are following much the same course as in 1923.

In the following table are shown the percentage increases monthly since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	—
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Alterations in corn prices were small, wheat showing an advance of 2d. per cwt. and barley and oats decreases of 1d. and 2d. respectively per cwt. The index number for wheat has advanced, and that for oats has fallen, by 2 points, while in spite of the decline in barley prices the index number has advanced, owing to the relatively greater decrease in prices in the pre-war years.

Potatoes have been falling slowly throughout the month, but they have far from lost the advance recorded during February,

BRITISH EMPIRE EXHIBITION.

Agricultural Research Exhibits.—The agricultural research exhibits at the British Empire Exhibition have already been briefly described in this *Journal*.* The exhibits are staged in a large gallery in the Government Pavilion—an imposing building guarded by six massive stone lions—an illustration of which was included in the issue of this *Journal* for January last. The position of the Government Pavilion is shown in the plan of the Exhibition on the extreme right of the plan. A bird's-eye view of the whole Exhibition faces this page.

The exhibits are arranged in cases in the following groups:—

I. The Soil	Cases A and B.
II. Plant Improvement	„ C. D. E.
III. The Health of Plants: Diseases and Insect Pests	„ F. G. H. I. J.
IV. Horticulture and Farming ...	„ K. L. M.
V. Animal Improvement	„ N. O. R. S.
VI. Fertility of Domestic Animals ...	Case Q.
VII. Animal Nutrition	„ P.
VIII. The Health of Animals ...	Cases T. and U.
IX. Agricultural Economics	Case V.

The exhibits, which have been organised by the Ministry in collaboration with the Board of Agriculture for Scotland, are confined to research and have been supplied by various Research Institutions in Great Britain.

Agricultural research presents difficulties to the exhibitor; its range is immense, and even if the selection be confined to aspects of special practical value the choice is still embarrassing. The selection that has been made, has been made for the most part by researchers themselves in an attempt to outline, as it were, the story of work which is now being carried on at research institutions and laboratories in England, Scotland and Wales. To many this story will be quite new.

A very full account of the exhibits has been published in the form of a guide, which contains a preface by Sir A. D. Hall, Chief Scientific Adviser to the Ministry, and extends to 66 pages. Copies of this guide can be obtained at the Exhibition, price 6d. It should prove of great immediate interest to farmers, and serve as an indication—though by no means a complete one—of the many directions in which research is striving to assist them.

* March, 1924, pp. 1116–19; April, 1924, pp. 3–4 and 9–14; and previous issues.

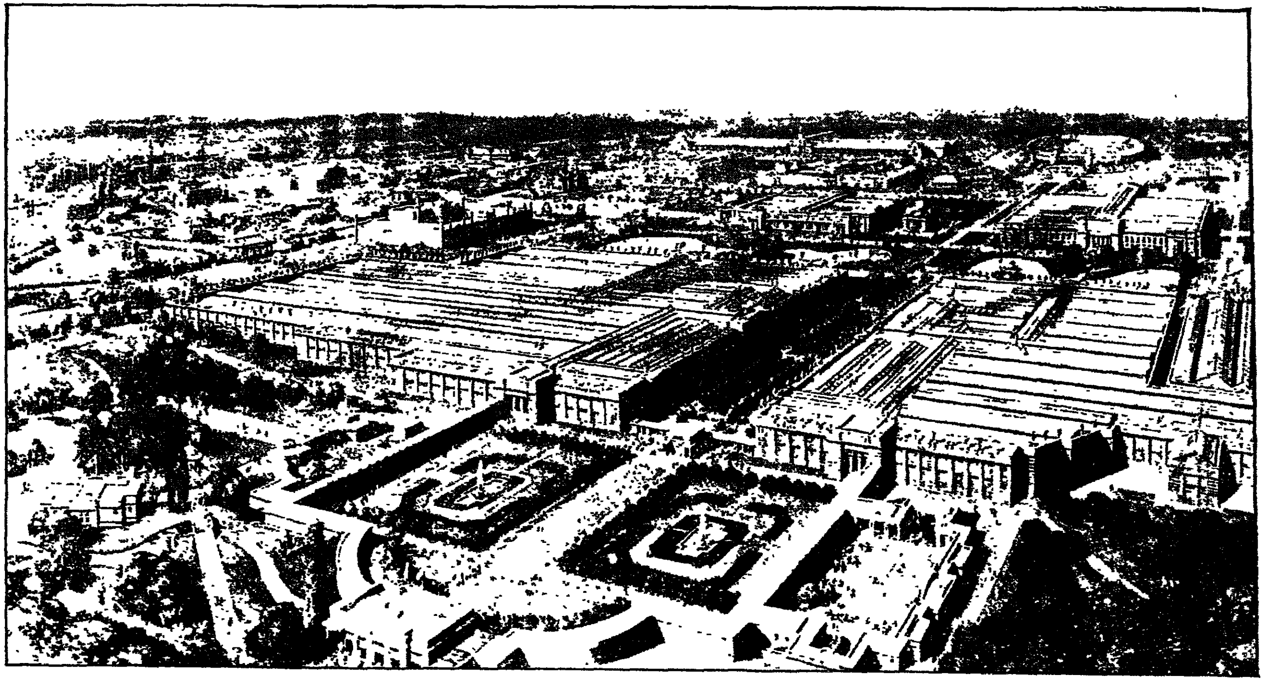

FIG. 1.—British Empire Exhibition—Bird's-eye view.

By Courtesy of the British Empire Exhibition.

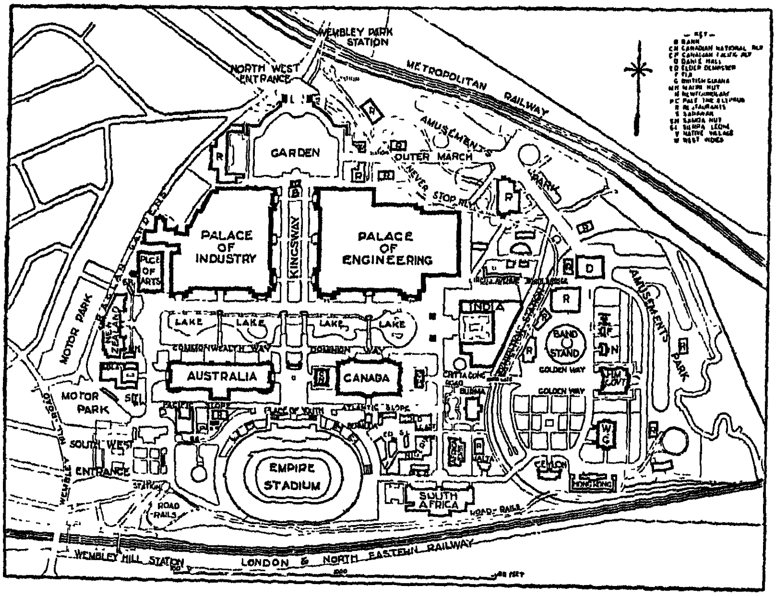

FIG. 2.—British Empire Exhibition—Plan.

By Courtesy of the British Empire Exhibition.

Films dealing with agricultural machinery, the production of home-grown beet sugar, clean milk production, and the improvement in British wheats for bread-making will be shown in the Government Pavilion during the course of the Exhibition.

Arrangements have been made for visitors to be conducted round the Gallery at intervals during the day, when short informal talks will be given by Mr. K. B. Williamson, M.A., Dip. Agric. (Cantab.), with the object of explaining the exhibits in a popular manner. The times will be shown on the notice board at the entrance to the Gallery. Arrangements will also be made as desired for the exhibits to be explained in a more detailed manner to parties of agriculturists and agricultural students.

* * * * * *

Licensing of Stallions under the Horse Breeding Act, 1918.

THE decline in horse breeding, as shown in the Agricultural Returns last June, when the number of stallions used for service was returned as 5,459 as compared with 6,074 in 1922, and the number of foals as 66,323 as compared with 83,890 in the previous year, is further emphasised by the records available up to 31st March last as to the number of stallions licensed by the Ministry for this season under the Horse Breeding Act, 1918.

While some further applications for licences may be received during the next two months the number issued up to 31st March last is only 1,692. The comparative figures for the last three service seasons are 3,113 in 1921, 2,747 in 1922 and 2,176 in 1923. The decrease in the number of licences issued is very marked in the case of Shire Stallions, and shows a reduction this season of nearly 55 per cent. on the figure for the 1921 season.

The revival of the award of grants by the Ministry to Heavy Horse Societies will, it is hoped, tend to encourage the travelling of more stallions than would otherwise be the case, but it is not anticipated that the effect of these grants will increase the number of stallions licensed this season.

After the close of the service season the Ministry will publish particulars, according to breeds, of the total number of licences issued, but the following information that is now available may be of interest to horse breeders:—

Service Season.	1921.	1922.	1923.	1924.
Shires	2,157	1,845	1,379	975
Other Heavy Horses	495	428	367	309
Light Stallions (including Ponies)	461	474	430	408
TOTAL	3,113	2,747	[illegible]	[illegible]

SOIL IMPROVEMENT.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

SOIL improvement may be attempted for two reasons: (1) to enable the soil to carry larger crops than before; or (2) to alter it somewhat so that it may carry crops it has not previously borne. Almost every soil has already the capacity of producing something, even if it be only ragwort and gorse. These, however, are not crops the farmer wants, and therefore he alters the soil so as to make it yield something of commercial value.

It is impossible to lay down any hard and fast rules as to soil improvement; an intelligent appreciation of the position is perhaps the chief necessity, though of course it may be desirable to seek the help of the County Organiser in running down some special factor that is causing trouble. One important point that works always in favour of the farmer is that the requirements of the plant are not rigidly fixed; the plant, like other living things, can adapt itself to some extent to its surroundings, and in particular the different varieties of the same crop differ in their requirements so that by suitable selection among these varieties it is possible for the farmer to simplify his problem a good deal. There is no form of wastefulness so bad as trying to grow varieties not well suited to the farm.

A second important factor in the situation is that the soil is only one of the partners in the concern, the other being the weather. The soil, the weather, and the crop should on the perfect farm all fit each other as a key fits a lock. Unfortunately in practice there is always some misfitting which it is the object of soil improvement to try to overcome. The result of the large part played by the weather is that there is no such thing as a perfect soil type good under all conditions. The utmost that can be expected is that the soil shall suit the climate. A soil property may be a serious defect in one set of weather conditions and a great advantage in others.

This is well illustrated by the following facts giving particulars of two soils one of which is a hopeless waste, while the other is fertile:—

Coarse Sand.	*Clay.*	*Location.*	*Annual Rainfall.*	*Value for Agriculture.*
93·7	Nil	Anglesey	35 in., water level only 3 or 4 ft. down	Good. Fairly prosperous small holdings—potatoes and carrots.
62·4	0·5	Wangford, Suffolk	About 23 in., water level very deep down	Absolutely nil. Waste land.

Both soils are very similar in type and both are poor; indeed the Anglesey soil on analysis seems to be the poorer of the two. The great difference between them lies in their water supply; one has less than 23 inches in the year and has no available reserve in the subsoil, the other has more than 35 inches and has a permanent supply 3 or 4 feet below the surface. The real defect of both soils is their inability to retain water; this is so serious a matter in the dry conditions at Wangford that it renders the soil absolutely useless for farm purposes; but it is a great gain in the wetter conditions of the Angelsey sand because it ensures that the excess of water can easily get away.

REQUIREMENTS OF PLANTS

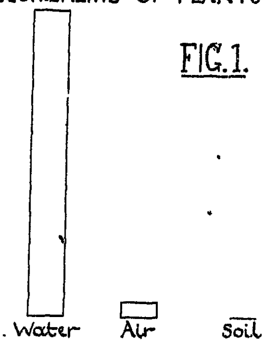

FIG. 1.

LOSSES OF FERTILISER CONSTITUENTS FROM SOIL OF BROADBALK WHEAT FIELD

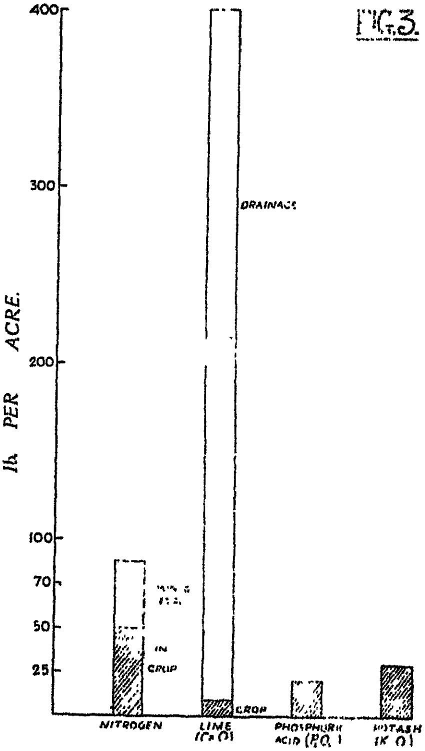

FIG. 3.

SPECIMEN OF DYNAMOMETER CHART

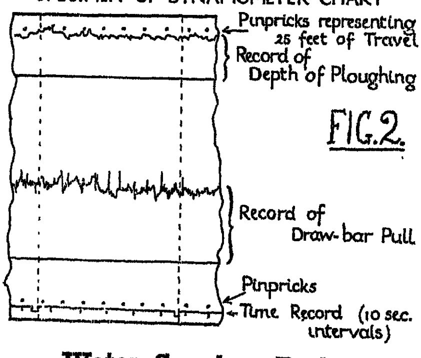

FIG. 2.

Water Supply.—Probably the most important thing to put right is the water supply to the plant. In many parts of the Empire this is done by irrigation; in Britain this method is not usually possible excepting in regard to meadows in the Severn valley and other parts of the south-west of England where flooding is a recognised and valuable procedure. In low-lying fen and silt regions of the eastern counties and in some

of the marshes of the south of England, especially Romney Marsh, all the advantages of irrigation are obtained by regulating the outflow from the ditches, thereby raising or lowering the water level in the soil as may be desired. Indeed this underground watering or sub-irrigation is one of the best ways of putting water on to the land. These direct methods are, however, the exception in Great Britain and not the rule, and other methods have to be adopted. The importance of the problem is illustrated by Fig. 1, the columns of which show the respective needs of the plant for water, air, and manure. The amount of food the plant takes from the soil when compared with the water is so small that it cannot be shown by a column but is indicated only by a line. If the food requirement of a crop were represented by a column 1 in. high the water requirements would need a column about as high as Nelson's column in Trafalgar Square.

The question of water supply is of special urgency in the eastern counties owing to the limited rainfall there. As often happens in British agriculture, the difficulty has been to a considerable extent obviated by the farmers, and indeed made to serve their ends. Here it is done by growing crops for seed, for which a low rainfall is desirable, since long experience has shown that high quality is best obtained in dry conditions.

However, the whole farm cannot be run for seed production purposes, and fodder crops are required for which a sufficient supply of water in the soil is essential. Over most of the country the water supplied by the rainfall would usually be sufficient if it could be kept in the soil as long as it is needed. Unfortunately the water is liable to be lost into the air by evaporation and into the subsoil by percolation. At Rothamsted on an average the losses from these two causes are about equal; about half the rainfall being lost by drainage and half by evaporation, but the proportion varies from month to month and from year to year. Thus on an average for the 52 harvest years, 1871-1922. the figures for an uncropped soil have been :—

	Sept.	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*
Rainfall (in.)	2·3	3·1	2·8	2·8	2·4	2·0	2·1	2·0	2·0	2·3	2·7	2·7
Per cent. lost by—												
Drainage	28	31	72	84	85	75	37	34	24	25	25	25
Evaporation	72	69	28	16	15	25	63	66	76	75	75	75

The variation for individual years has been considerable, as is illustrated by the very hot dry 1921 and the cold unpleasant 1922.

FIG. 4.—Field 40, Garforth, ploughed out from old pasture 1917-18. (Looking North). Date photographed, September, 1920. Barley Crop.
Right.—Plots 14 and 15 of old series of grass plots laid down 1898-99. Plot 14, 6 tons of quick lime per acre 1898. Plot 15, 6 tons of gas lime per acre 1898.
Left.—Plots 11 to 13 of old series of grass plots, which did not receive lime. The white flowers are Yarrow, and the grass is Bent *(Agrostis stolonifera)*.

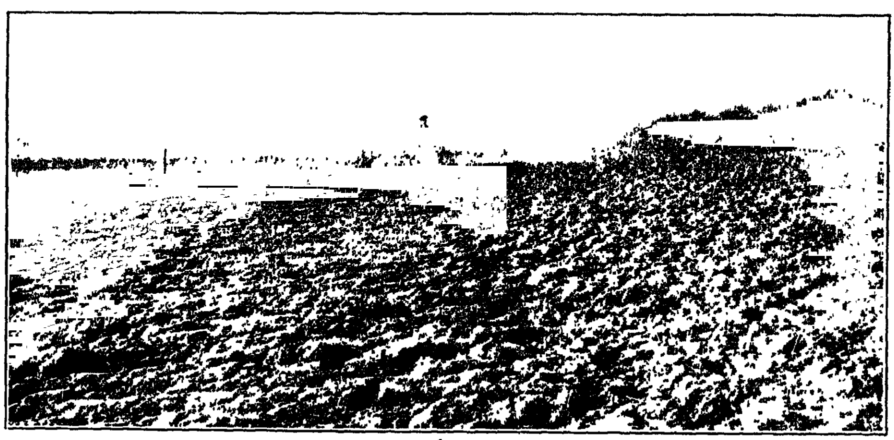

FIG. 5.—Field 40, Garforth, ploughed out from old pasture 1917-18. Date photographed, February, 1921. First ploughing after harvesting the 1920 Barley Crop. Other particulars as for Fig. 4.

Sept.—August	*Average 52 years* 1871–1922	1921	1922
Rainfall (in.) ...	29·24 ...	16·09 ...	29·78
Per cent. lost by—			
Drainage ...	49·5 ...	34 ...	47
Evaporation ...	50·5 ...	66 ...	53

In the Soil Physics laboratory at Rothamsted careful studies are being made to find out the inner mechanism of these losses, and if possible how they can be reduced. Special cylinders have been filled with various types of soil and exposed to the weather, and measurements are taken to discover the movements and losses of water that occur. As yet there is little to give in the way of advice beyond the fact already known in a general way, but made definite by many measurements at Rothamsted, that surface cultivation, farmyard manure and green manuring all reduce loss of water and so serve to maintain a sufficient supply in the soil. At Rothamsted the plots receiving farmyard manure contain in a dry spell some 5 per cent. or more moisture in excess of those not so supplied.

Soil Aeration.—Closely connected with the water supply is the air supply for the roots. Everyone knows that roots suck up water and food from the soil; it is not so well known that they breathe, and that if they are suffocated through lack of air they will perish as surely as if they were animals. There are two ways in which they may be affected. Like animals and human beings, plants continuously breathe in oxygen from the air and breathe out carbonic acid, but unlike the case of animals this breathing process goes on in all parts of the plant, including the roots. It is of course true that plant leaves during the day take in carbonic acid and give out oxygen, but this action is confined to the green parts of the plant and goes on only when the light is good enough. On the other hand, every part of the plant, roots included, breathes in oxygen, and unless there is sufficient fresh air in the soil the roots suffer. The second effect arises from the fact that plant roots are poisoned by too much carbonic acid. This action is more serious than was formerly supposed, and it is now known that considerable injury may result to the crop unless a way out is found for the carbonic acid in the soil.

One of the useful properties of both air and carbonic acid is that, like other gases, they can escape upwards, sideways, or downwards if a reasonably clear way is left for them. The Rothamsted soil is heavy and not easily pervious to air, nevertheless in the arable land the air in the soil is not usually more impure than in many rooms in houses or halls where meetings

are going on, though in extreme cases there is of course a considerable difference. Some of the analyses are:—

COMPOSITION OF THE AIR OF SOILS (PER CENT. BY VOLUME).

Soil.	*Usual Composition:* *Oxygen.*	*Carbon dioxide.*	*Extreme limits observed:* *Oxygen.*	*Carbon dioxide.*
Arable land, unmanured	20·4	0·2	18·0-22·3	0·01-1·4
Arable land, dunged ...	20·3	0·4	15·7-21·2	0·03-3·2
Grass land	18·4	1·6	16·7-20·5	0·03-3·3
Atmospheric Air ...	20·9	0·03		

At first sight it seems strange that air can get in and out of so solid looking a substance as soil, but as a matter of fact soil is nothing like as solid as it appears, but is full of pores which occupy a good deal more space than might be thought. Some of the figures obtained at Rothamsted show that 100 volumes of field soils there contain the following percentages of solid matter:—

	Solid Matter.	*Space empty, except for air and water.*
Unmanured arable soil ...	66	34
Well dunged arable soil ...	62	38
Pasture soil...	53	47

An exhibit has been put up at Wembley showing what the apparently solid soil would look like if it were magnified several hundred times. In the normal moist state about three-quarters of the pore space of the arable soil, and four-fifths that of the pasture soil, would be filled with water and the remainder with air. In many soils, especially in the western parts of England and the whole of Wales, the great obstruction to a free air supply and the escape of the injurious carbonic acid is the excess of water in the soil. Drainage is the well-known remedy. In the present economic conditions the individual landowner is not likely to attempt it, and indeed the individual is always handicapped in draining operations unless he can work over a sufficiently large area to take in the whole drainage system, because it is impossible to obtain the full benefits unless the whole watercourse is kept clear and the lands above and below are drained. It is hoped that the new schemes of credits instituted by the Government will facilitate these large scale drainage operations.

Cultivation.—Once the land is drained the great method for maintaining a suitable air and water supply is cultivation. Little has been done to study this ancient art, but a good beginning has been made in the Soil Physics Department at Rothamsted, and measurements are now taken of the work that has to be done in carrying out the various processes. It

has been shown that the amount of labour necessary is very appreciably influenced by the soil treatment; thus addition of chalk, lime or farmyard manure markedly diminishes the pull required, and certain artificials also act in the same way. The chalk does not show any effect if the land is very wet or very dry. Some of the Rothamsted results are:—

Material used.	*Condition of soil.*	*Percentage reduction in power required to plough, as compared with unmanured land.*
Chalk	Stubbles, dry	Nil
	Oct., distinctly moist ...	14·7
	Jan., very wet	4·6
Farmyard manure	Hoos barley field ...	22·6
Coarse ashes	" " " ...	12·3
Super and sulphate of potash mixed	Broadbalk wheat field...	14·2
Super and sulphate of potash mixed, + 200 lb. sulphate of ammonia	" " "	12·7
Super and sulphate of potash mixed, + 400 lb. sulphate of ammonia	" " "	16·3
Super and sulphate of potash mixed, + 600 lb. sulphate of ammonia	" " "	21·5
Super and sulphate of potash mixed, + 275 lb. nitrate of soda	" " "	8·1

Fig. 2 shows one of the charts made by the dynamometer, from an accumulation of which these figures are worked out. The experiment deserves repetition on other types of soil, the saving in power being quite considerable.

Another highly interesting investigation begun in the Physics laboratory has shown that the resistance to the plough may be considerably reduced by means of an electric current which could be generated by the tractor. The investigation is as yet only in the laboratory stages, but the principle is sound, and the technical difficulties may yet be overcome.

Depth of Soils.—Another factor greatly influencing the air and water supply is the depth through which the plant roots can range. It is a common defect of many soils that they are too shallow; what there is of them may be very suitable for the plant, but there is not enough. The trouble has been intensified on the heavier soils in the eastern counties by the custom common 30 or 40 years ago, and still surviving in places, of ploughing to a uniform shallow depth, sometimes with a heavy plough. The result is the formation of a plough

sole through which plant roots have great difficulty in penetrating. Very beneficial results have been obtained in Essex from subsoiling, which allowed the roots a bigger range and enabled them to get at more of the water supply. There is no evidence that any appreciable amount of food is derived from the lower soil thus opened up, but the larger and more uniform water supply enables the plant to make full use of the food materials present in the top soil or added in fertilisers without the wastage that at present often goes on.

Even where the ploughing has not been persistently shallow subsoiling has often proved an advantage. At Rothamsted it gave an additional half ton of potatoes without the use of any more manure.

Unfortunately there are many cases where the thin soil is underlain by rock or gravel, and here nothing can be done to deepen the soil beyond the artifices already known to the farmer.

The Re-action of the Soil: Sourness.—One of the most important factors in determining the value of the soil for crop production is its state of sourness or otherwise; in chemical language its reaction. The practical remedy is of course well known: it is to apply lime in one or other of the forms available—either lump lime, ground lime, or limestone, whichever on analysis appears to be the better value at the farm. Farmers can tell without difficulty when grass land has become sour; the change in character of the herbage, the weakening of the clovers, the dark green unhealthy colour of some of the grass, and above all the patchiness of the pasture, are all reliable indications. In our experience, however, farmers have more difficulty in recognising when the arable land is sour, and we have had several cases referred to us of crop failure without apparent cause, which on examination turned out to be simply sourness. Crops vary in the ease with which they show the "souring" effects; oats and potatoes do not show up as sharply as swedes or mangolds. Again the patchiness is a usual indication. Another indication is the failure of the root system to develop; mangolds, for example, in sour land refuse to grow up, remaining small undeveloped plants with roots that will neither spread into the soil nor swell out, while their foliage is yellowish and unhealthy looking.

Before sourness has got as far as this it may well have caused much loss to the farmer through failure to obtain the full benefit to which his expenditure on cultivations and manures entitles him. It is therefore very important that the agricul-

tural advisors should be in possession of methods whereby they can ascertain whether the soil is becoming acid before any important loss has occurred. The farmer can, if he likes, disregard the warning, but at any rate he will know where he stands. For some years past the Research Institutes have been busy devising various methods, and one is now in use at Rothamsted which enables the analyst to "place" the soil on the scale and to say whether it still has a margin of safety or whether it is becoming rather dangerously near the limit.

In connection with this investigation certain field experiments on liming have been organised by the Ministry of Agriculture and are being carried out by County Organisers, and it is hoped as a result of the work to be able to advise farmers within a few cwt. per acre how much lime they should add to bring the soil within the safety zone. The scale as used at Rothamsted and elsewhere is based on a system of measurement of what the chemist terms the PH values, in which 7 represents the perfect neutral condition, 4 represents a bad acid condition in which no crop will grow, and intermediate values represent conditions which certain crops will, and others may not tolerate. Values higher than 7 are not common in this country, but they occur among the alkali soils found in parts of the Empire.

It is not sufficient to put the reaction of the soil right by adding the proper amount of lime; unfortunately for the farmer it will not remain right. Of all soil constituents none is so seriously liable to loss as lime. We hear a great deal about loss of nitrates from the soil in a wet winter, and owing to their cost it is quite proper that we should, but the loss of lime is on a far greater scale. Fig. 3 shows in diagram form what happens in a single year to the fertilising constituents of the soil in which a crop of wheat is growing. A certain amount of each of them is withdrawn from the soil. In the case of potash and of phosphate practically the whole of the material so withdrawn finds its way into the crop and is thus usefully employed. In the case of nitrogen the amount drawn from the soil is much greater, and here only part—in this case about one-half—gets into the crop, the remainder goes into the drainage water. This loss is serious and expensive to the arable farmer, and is particularly marked in a wet winter; in a dry season where the plant is making better root it is diminished. Methods of reducing these losses are being tried at Rothamsted, this work forming an important part of the investigations on soil improvement.

THE FEEDING OF ANIMALS.

PROFESSOR T. B. WOOD, C.B.E., M.A., F.R.S.,
Drapers Professor of Agriculture, and Director of the Animal Nutrition Research Institute, University of Cambridge.

THE feeding of animals is undertaken for the most part with the object of converting the coarser produce of the soil into animal products for human consumption. This is at once both wasteful and necessary: wasteful because on the average the food-producing live stock of Great Britain consume about 40 lb. of the produce of the soil, weighed in the dry state, for every lb. (also weighed dry) of edible animal product they produce; necessary because it is only through the agency of animals that the coarser and more bulky produce of the soil, such as hay, straw, grass and roots, can be converted into human food.

Granted the necessity for this wasteful form of food production, it is clearly most desirable that every effort should be made to reduce the wastefulness to its lowest possible limit. Hence the need for research in animal nutrition.

Broadly speaking, two kinds of research are required. In the first place we need scientific research into the fundamental aspects of nutrition, which to the man in the street may appear to be as far removed from agricultural application as were Faraday's experiments with a magnetised needle in the cellar of the Royal Institution from their present-day application—the electric motors which propel the underground trains and the dynamos which provide them with the power they need. Secondly, we require practical research, which is, or should be, concerned with working out the practical application of the ideas originated by the fundamental investigators.

Both these types of work are in progress in Great Britain at the present time, the former being chiefly concentrated at Cambridge; at the National Dairy Research Institute at Reading; and at the Rowett Research Institute at Aberdeen. The more practical research into the application of fundamental principles to the practice of economic feeding is at present undertaken, not only by the three Research Institutes mentioned above, but by most of the agricultural colleges and by some of the farm institutes and county organisers connected with the county councils. In this branch of the work there is room for the organisation of team work. At present each investigator works on independent

lines, which is excellent for really original research but is apt to fail in yielding reliable practical results of immediate general application. Notable exceptions are the excellent practical results which have been obtained in several areas by the rationing-for-milk schemes worked in connection with milk recording.

The Cambridge Animal Nutrition Institute has worked chiefly at the general relation between the quantity of fodder consumed and the quantity of meat produced, and its more important results have recently been published in a small volume entitled *Animal Nutrition*, written by the Director and published by the University Tutorial Press. This volume sets out a system of rationing all kinds of animals in accordance with the result which the feeder desires to produce. A second section of the Institute, under the direction of Dr. F. H. A. Marshall, F.R.S., Reader in the University in Agricultural Physiology, has investigated the physiology of reproduction in farm animals. Perhaps its most important achievement is the demonstration that sterility in mares and cows is frequently caused by the persistence of the "yellow body" in the ovary. This has been given practical application in a simple operation by which the "yellow body" is squeezed out, when the animal again becomes capable of breeding. Other problems which have engaged the attention of the Cambridge staff are the separation and characterisation of the proteins of various fodder crops, the strength of wheat flour, the digestibility of various home-grown fodders, and the growth and development of various breeds of live stock. A poultry section has recently been added to the Institute.

The Rowett Research Institute at Aberdeen, under the direction of Dr. J. B. Orr, D.S.O., has only been completed since the war. It has, however, already developed a characteristic line of investigation, namely, the importance of the ash constituents of the diet on the growth and development, and especially on the health, of animals. This important subject has never received the attention it deserves, and in Great Britain has been scarcely touched. Already Dr. Orr and his staff have clearly demonstrated that an inadequate supply of ash constituents produces an immediate and direct effect on the well-being of animals comparable with the effect of deficiency of vitamins, for which it is frequently mistaken.

INSOLVENCIES AMONG FARMERS.

A. W. ASHBY.

UNDER all possible circumstances and in the very best of times a certain number of farmers not only fail to make their enterprises profitable, but lose a part or the whole of their original capital.

The causes of insolvency amongst farmers are many and varied. They may be either wholly personal, or wholly economic, or personal causes and economic causes may combine to make individuals insolvent. Or special causes may be some form of disaster arising from natural phenomena such as drought or flood. On the whole, the personal causes are predominant. This cannot be doubted when it is remembered that the average number of bankruptcy receiving orders and deeds of arrangement for 10 pre-war years amounted to 317. The highest recorded numbers since records were first made available in 1891 were :—

1893	523
1894	518
1895	564
1896	466
1897	407
Average 5 highest years ...	496

As the average for all the years from 1891 to 1923 is 352, and this includes the worst years which have occurred, and the best which can be imagined, as for instance 1918 when the number of cases fell to 33; and as the average for the five fairly normal years of 1909 to 1913 was 304 cases, about 300 cases per year must be the normal expectation. In this case, the figures which represent the pressure of general economic forces upon the industry in general, and upon individuals in particular, are those in any year which are in excess of 300. In 1895, the worst year of any recorded, for instance, about 264 of the 564 cases represent the pressure of general economic forces. Again, in 1923, of the 482 recorded cases about 182 represent the effect of pressure of general economic forces.

The personal causes of failure are of a varied character. The cause may be lack of knowledge or experience of the industry, general inefficiency or inattention to business, or living in excess of income while the business is paying moderately well.

Special economic forces may be (*a*) speculative production, (*b*) lack of capital, or even over-capitalisation, and (*c*) in some

cases "over-reaching" of business capacity or capital (or, as the general trader would say, "over-trading").

General economic causes are mainly connected with changes in price-levels, either (1) of nearly all commodities, as in 1921, or (2) of special groups of commodities, as in the case of cereals in the 'nineties, or (3) in the price of one article of specialist production, such as hops. These press heavily on all farmers or on special groups of farmers according as they cover all commodities or special groups. These price changes and their effects are illustrated by the figures for insolvencies between 1893 and 1897, and again since 1921. The causes arising from natural phenomena may also be varied in character, or operate on a national or local scale. A local flood or a local drought or hailstorms may affect the farmers in special localities, or the whole country may suffer from abnormally high rainfall or from drought. Particular farmers or a local group may suffer from diseases amongst animals or pests amongst crops. But when all is said that can be said of causes of insolvency, it remains true that the normal expectation must be about 300 cases, and it is probably true that in two-thirds of these cases the cause is connected with the person in charge of the business or with the conditions of the individual business itself. The remaining one-third may be due to causes not under the control of the individual manager which arise from natural phenomena or from economic conditions.

This being the case it is necessary to measure the proportion of failures which occur amongst farmers, and so far as insolvency becomes public the following figures represent the proportion of insolvent businesses to the total:—

Average of 5 years—1909-13	17 in 10,000
Year 1912	19 " "
" 1913	18 " "
" 1921	16 " "
" 1922	22 " "
" 1923	27 " "

It is more difficult to estimate the proportion of total farming capital lost in insolvent businesses, but it appears that in pre-war years about £17 in £10,000 of the total of farming capital, or in 1922 about £22 in £10,000, was so lost.

When insolvencies are caused by general economic forces there may be some lapse of time between the operation of the forces and the actual declaration of insolvency. But this lapse

is not so great as might be expected, for it amounts to only about one year, and when, for instance, price changes are violent it may be less. Taking the post-war years, it is found that the number of cases increased very much from 1920 to 1921 and has continued to increase until the last year. But if prices now remain stable it may be expected that the number of cases of insolvency will diminish. Taking the figures for the last three years, as follows:—

1921	285
1922	403
1923	482
Average ...	390

it may be seen that the actual occurrences are not much in excess of normal expectation, and that in the case of the last big decline in prices there was not a great lapse of time between the price change and the increase in insolvency.

During the recent depression of prices it might have been expected that there would have been more insolvencies in the arable area than in other areas of England and Wales. In so far as information is available, this does not appear to have been the case, for *as regards the number of cases of public insolvency* occurring amongst farmers the pasture areas have suffered more than the arable areas. When, however, the liabilities in cases of insolvency are considered, the results of *bankruptcy* are fairly well distributed over the whole country.

The liabilities in cases of public insolvency, as well as the number of cases, have been heavy during the last two years. If, however, allowance is made for the change in the value or purchasing power of money, these are not much greater than in pre-war years. For the five years before the war the average yearly amount of total liabilities was £325,500, and the average of liabilities per case £1,070. During 1921 the total of liabilities amounted to £826,800 or £2,900 per case. When the 1921 figures are reduced by the index number of general commodity prices, which stood at 219 as compared with the pre-war index, these sums are reduced to £444,500 and £1,560 respectively. Similarly, the liabilities for 1922, which in sterling amounted to £768,000 or £1,906 per case, fall to £489,000 and £1,214 respectively when reduced to pre-war values.

IMPROVEMENT OF GRASSLAND IN YORKSHIRE.

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EXPERIMENTS on the improvement of grassland have been in progress on the experimental farm of the University of Leeds at Garforth, and at other centres in Yorkshire, for upwards of 30 years, but in 1919 the number of centres at which grassland experiments were laid down was largely increased, until at the present time there are about 50 series of plots, in addition to those at Garforth, on private farms throughout Yorkshire. Yorkshire farmers have co-operated so willingly, and have put such numerous types of soils and grassland at the disposal of the University that a great deal of useful information on the treatment of poor grassland is now being accumulated.

A brief account of the results obtained up to the end of the season of 1923 may be useful.

Use of Lime.—The older experiments, together with the experience of many grassland farmers, appeared to indicate that large areas of poor grassland did not respond readily, and some not at all, to phosphatic manures. Even the old form of high grade basic slag, the use of which revolutionised grassland manuring on large areas of land throughout the country, appeared to have little or no effect on permanent grassland of certain types in Yorkshire. It was noticed, moreover, that where this lack of response to phosphates was experienced, liming was often very effective.

The first series of experiments laid down was designed to deal with this problem, and grassland was chosen which showed those signs usually regarded by the practical man as pronounced indications of want of lime.

At first eight distinct types of soil were chosen, and the fields selected for each type were the worst which could be found at the time, when judged by such signs of want of lime as a general absence of clover, the prevalence of bent and other unpalatable and badly grazed plants, and the accumulation of partially decayed vegetable material usually referred to as a "skin" or "mat" on the surface of the soil. The eight centres originally selected in 1919 have since been increased as opportunity offered, usually through the channel of advisory work.

Table I contains a list of centres, including the eight referred to above, on which lime and slag have been used and which are

EXPERIMENTS WITH LIME AND BASIC SLAG.

Soil.	Centre.	Expt. begun.	*Lime Requirement.	Effect of Lime.	Effect of Slag.	Effect of Lime followed by Slag.	Effect of Potash.
Coal Measures Soils	Batley	Spring 1920	60	After three years noticeable improvement	No apparent improvement	Similar to lime alone	Slight additional improvement where used with lime
	Sharlston	do.	49	do.	do.	do.	do.
	Nostell	1921	25	After two years noticeable improvement	Some improvement	—	—
	Parlington	1920	23	Slight improvement (Limestone used)	Marked improvement	—	—
Millstone Grit Soils	Silsden	Spring 1920	30	After three years very marked improvement	Noticeable increase in amount of clover	Best plot	Improvement where used with Slag or Lime
	Saddleworth	1919	56	Noticeable improvement from quicklime and carbonate of lime	No apparent improvement	—	—
Light Sandy River Alluvial Soils	Beamsley	Spring 1920	22	After three years marked improvement	Noticeable increase in amount of clover	Noticeable improvement	—
	Bolton Abbey	1921	15	After two years slight improvement	Marked improvement	—	No noticeable improvement

already showing definite signs of improvement due to applications of either lime or slag.

The results of these experiments indicate that such poor, badly-grazed grassland can be divided roughly into three classes:—(1) land which will not respond to phosphates (including high grade basic slag) but which responds to lime; (2) land which is not noticeably improved by liming but which responds in a wonderful way to suitable phosphatic manures; and (3) an intermediate class which is improved either by liming or by the application of phosphates.

Soils that need Lime.—The outstanding characteristics of grassland in Class (1) are:—

(*a*) The presence of a "skin" or "mat" well seen in section if a turf is dug out with a spade. This "mat" is so tough that it is impossible in the worst cases to work through it to the soil below with the finger. It must not be confused with the layer of dead material which may accumulate by two or three years' insufficient grazing, and which can easily be worked through with the finger; in such cases where the soil can easily be touched the grassland belongs more probably to Class (3) or even Class (2).

(*b*) The almost complete absence of clover and perennial rye-grass.

(*c*) The presence of a large proportion of bent (*Agrostis vulgaris*) and creeping bent (*Agrostic stolonifera*) often called water grass.

(*d*) The comparatively small number of species of plants represented.

The soil of such land when examined in the laboratory has a high "lime-requirement," usually over 40 (*see* Table I), or sometimes as low as 30 in the case of light sandy soils.

As a rule any bare spaces in the turf are covered by the usual "mat," and the soil is not exposed. In smoky districts, however, the "mat" becomes blackened and breaks easily, owing apparently to the action of the smoke, and if the covering of such material over the soil is thin, some weeds, especially sheep's sorrel and sometimes yarrow, take possession of these bare spaces.

In some parts of Yorkshire the herbage includes more typical moorland plants such as moor mat grass or white bent (*Nardus stricta*), heath bedstraw (*Galium saxatile*), heather and bilberry, and there are many instances of remarkable improvements, still showing plainly, which were effected by applications of lime up to 50 years ago. Some of these patches have been included

in experiments recently laid down, *e.g.*, slag has been applied with very good results to such areas which had been previously limed, but where such a slag plot has been extended so as to include areas not previously limed there has been no noticeable improvement from the application of the slag.

The soils on which this grassland, which responds so well to applications of lime, occurs, are derived chiefly from Coal Measures, Millstone Grit, Yoredale Grit and Moor Grit, the first three in the West Riding, and the Moor Grit in the Scarborough-Whitby-Pickering area. The worst cases occur as a rule where there is no Boulder Clay, although in places where the Glacial Drift consists largely of Grit material, *e.g.*, in a thin covering of drift overlying Grit rock, the need for lime is often very pronounced. As a general rule the Boulder Clay of the West Riding gives rise to soils with an apparently higher lime-requirement than the Boulder Clay occurring further east; partly because of the higher rainfall in the west, and partly because there is a higher percentage of chalky material in the East Riding Boulder Clays. In the West Riding where the Boulder Clays overlay limestone or Yoredale Shales the grassland will often respond readily to phosphates without a previous application of lime.

Effect of Lime.—On matted types of grassland the first improvement noticeable after liming is a pronounced stimulus to the grasses. If the lime has been applied during winter or early spring, the limed plots usually stand out because of the fresher, greener herbage they carry during the spring, even if the lime has only been applied a few weeks previously. In some cases a magnesian lime has given more marked results than a pure lime. Two or three years after the application of the lime the most marked alteration in the herbage is a large increase in the proportion of fescue and a corresponding decrease in the proportion of bent (*Agrostis*).

TABLE II.

EFFECT OF LIME ALONE ON FESCUES AND BENT.

Centre.	Year when lime applied.	Year herbage analysed.	Percentage area covered.			
			Fescues.		Bent.	
			Not limed.	Limed.	Not limed.	Limed.
*Garforth ..	1911	1917	17	29	26	7
Batley ..	1919-20	1923	34	46	17	1
Sharlston ...	"	"	27	31	25	6
Silsden ...	"	"	21	43	22	4

* Percentage of fescues and bent in hay (not percentage area covered).

The most important point about liming, however, is the way in which it prepares the land for subsequent treatment with phosphates which complete the improvement. Some of the better grasses, and particularly perennial ryegrass, do not appear to be nearly so tolerant of "acid" soil conditions as wild white clover.

An important factor checking the development of clover is the presence of a "mat" and the coarse and badly-grazed grasses, particularly bent; under such conditions the clover is suppressed —it is over-shadowed by grasses during the whole of the growing season, and on account of the mat cannot get its runners into contact with the soil. Liming gradually reduces the mat and exposes the soil. Some of this work appears to be accomplished indirectly by earth-worms. The work of earth-worms appears to be stimulated by liming, and on more than one occasion the limed plot has been located on grassland through the presence of a larger number of worm-casts.

On some of the Millstone Grit pastures, where the conditions are often semi-moorland, liming will encourage the spreading of wild white clover to an extent comparable with that obtained by applications of basic slag to such soils as the boulder clays. A further important point about the use of lime on some grassland is that the increased growth of wild white clover is thereby made more permanent. The deficiency of lime is usually a much more serious drawback to the improvement of bad grassland on these West Riding soils than the deficiency of phosphate, although as soon as the lime has begun to alter the sour conditions a further improvement may be effected by applications of phosphate. This has been most marked on the Silsden plots.

(*To be concluded.*)

* * * * * *

ESTABLISHING A TUBERCULOSIS-FREE DAIRY HERD.

S. E. B.

WITH the ultimate object of obtaining a herd free from tuberculosis, 250 cows and heifers under the management of the writer were subjected to the tuberculin test* in the autumn of 1922. The animals tested consisted of 121 milking cows located on three different farms, and 128 heifers of varying ages from 6 months upwards.

All the animals with the exception of 11 cows were home-bred. It was hoped that a nucleus of tuberculosis-free animals

would be obtained to start the immediate production of Grade-A Tuberculin Tested Milk, for which a demand was known to exist.

As, however, the principal object of the test was the establishment of a tuberculosis-free herd, extraordinary care was taken to eliminate, not only the animals definitely reacting to the test, but to exclude animals about which there was even the slightest suspicion. There is little doubt that, though this policy has now proved to be the correct one, the rigorous treatment classed many animals as reactors which probably were not so in reality.

The services of a veterinary surgeon who had had wide experience in this class of work were obtained, and he appointed a fully qualified assistant who resided on the estate during the time the testing was in progress.

The ultimate success obtained in the subsequent "tests"—as will be shown later—was due to the extreme care with which the actual inoculations were performed, and more especially to the manner in which the results were recorded and interpreted.

Method of Testing.—Tuberculin test sheets were printed, and a separate sheet was used for each animal. The form of this sheet is shown on p. 140.

The subcutaneous, ophthalmic, and intradermal tests were applied simultaneously.

As far as possible all animals were subjected several days before inoculation to the same conditions under which they would be tested, *i.e.*, they were tied up day and night, fed, watered and milked at fixed times, and made to become accustomed to the presence of strangers, and lights in the sheds at night. This was not a serious business as far as the cows were concerned, but for the young stock which were being "handled" for the first time, it was found necessary to allow at least two full days between tying up and inoculation.

Temperatures were taken at 7 a.m. and 5 p.m. on the day previous to inoculation, and the following day at 7 a.m., 5 p.m. and 10 p.m., at which last hour inoculation took place. In the original "test" post-inoculation temperatures were taken at the 9th, 12th, 15th and 18th hours, an examination of the eyes only being made at the 6th hour. In the subsequent tests the hours of pre- and post-inoculation temperatures were altered to comply with the Ministry of Health's

regulations. After the 18th hour in doubtful cases temperatures were taken, and "eye" and "tail" examinations made at the 21st and 24th hours, and later, if necessary.

TUBERCULIN TEST SHEET.

Temperature (Before inoculation).		
		Animal ....
		Breed........ Sex .. Age....
		Tuberculin .... Dose .
		Date .. .... Time .... Place . ....
		Average Group Temperature .. .... Result . ....

At Inoculation.		*Eye Reaction.*	*Tail Reaction.*	*Remarks.*
(Hours after inoculation) 6th				
9th				
12th				
15th				
18th				
21st				
24th				
36th				
60th				
84th				
108th				

Any animal which showed even a single abnormal pre-inoculation temperature was put back to be tested in a subsequent group.

As the taking of temperatures and the inoculation of nearly 250 animals within the space of three weeks was not only rather a large but a tedious operation, it may be of interest to describe the method of procedure which was finally adopted, and which proved the quickest and most saving in labour.

Animals which had never been tied up before were driven 3 to 6 at a time into a large calving box. One man, B, was stationed at the door of the box, whilst another man, A, went inside and threw a looped rope over the head of the first animal he could thus lassoo. A then drove this animal to the door, which B opened, and which A closed as he came out. Meanwhile, two other men, C and D, had passed the free end of the rope through the ring or staple from which hung a cow chain where it was intended the animal should stand. As soon as the animal bolted from the box, C and D, and subsequently B, hauled in the slack while A guided the animal, and prevented it as much as possible from injuring itself. As soon as the heifer had been drawn and coaxed up to the manger, A and B chained her up. In this manner all of the 128 heifers were in turn secured without accident.

Taking Temperatures.—The most convenient number of animals to deal with at a time was found to be between 30 and 40. For the temperature taking, which was done throughout by the resident veterinary surgeon, two stockmen and a clerk were employed. The writer, with the aid of the stockmen to steady the animals, inserted four thermometers, one into the rectum of each of four animals, the clerk noting the time when the first thermometer was in place. As soon as the first thermometer had been in one minute it was taken out by the veterinary surgeon, the reading announced to the clerk, shaken down, and inserted in the next, *i.e.*, the fifth in order of standing. The employment of the two stockmen was found to be absolutely necessary; their duties consisted of occasionally "nosing" refractory animals, but more especially guarding against the loss or breakage of thermometers by their being forced out during defecation.

Inoculation.—At the time of inoculation, excluding the veterinary surgeon and the writer, five men were employed. Whilst the former was preparing his syringes and materials, his assistant, with two men and the clerk, took and recorded the temperatures. Before this was completed the veterinary surgeon, with the aid of two men, started the inoculations, one man holding the lamp, and the other holding the animal by the nose with a pair of "bulldogs." As soon as the temperature taking was finished the two men who had assisted at it were sent home, and the assistant helped the veterinary surgeon by filling and handing him the syringes as required. In the above manner it was found possible, without fuss or unduly exciting the animals, to inoculate 80 in just over the hour.

The above description of the securing and the inoculation of the animals may appear superfluous, but, in the writer's opinion, this method adopted from the start resulted in each animal being treated quickly, quietly and efficiently, and it not only saved much time in the long run, but tended to eliminate the possibility of abnormal rises in temperature.

Results of First Test.—The first test showed that the herd in general was heavily infected, and, as might be expected, a heavier percentage of "reactors" among the milking cows than among the young stock. The results obtained from the latter are given in Table 1.

Table 1.—Tests of Young Stock

No. Tested ...	128			
No. Passed ...	71		*Percentage passed* ...	55.4
No. Failed ...	57			
Under 1 year old (20) ...	45	per cent. passed...	Average age in months	9
1 and under 2 years (46) ...	65.2	" " ...	" " "	15
2 and under 3 years (47) ...	51	" " ...	" " "	29
3 years old and over (15) ...	53.3	" " ...	" " "	39

As soon as each batch of animals had been tested, those which passed were immediately separated from the rest, and were sent to sheds or yards which had been thoroughly cleaned and disinfected beforehand, and which had held no live stock since the previous spring.

Effect of the Test.—The effect of the test upon the reacting animals was most marked, and from close observation at the time, and from their subsequent history, it would appear that they suffered in direct proportion to the degree to which they were affected with tuberculosis. The cows in milk, and the recently calved heifers, received the biggest setback. The reaction to the tuberculin, from a clinical point of view, appeared to be at its height at about the sixth hour (4 a.m.). The reacting animals had a distinctly hang-dog appearance, their coats were "stary," their skin felt hidebound and hard and dry to the touch, their muzzles were hot, and in general the animals looked ill at ease.

The immediate effect on the young stock was much less marked, but for several weeks subsequent to the test the animals, which were previously in good condition, ceased to "do," and in many cases actually lost in condition. The above observations were amply confirmed by the independent witness of the cowmen and stockmen in charge of the animals. The ill effects of the test on the reactors had completely disappeared three months after it had taken place.

It does appear that the tuberculin test in some way stirs up, and in some cases actually advances a stage, the progress of the disease in the animal.

In no single case did the test appear to affect the health of the non-reacting animals. Herd owners must, however, be prepared, even in herds free from tuberculosis, to expect a slight temporary falling off in the milk yield during and immediately subsequent to the testing of the cows, but this is attributable to the disturbance necessitated by the actual inoculation and temperature taking; and it is chiefly noticeable among the more excitable animals, and the heavy milkers.

Results of Subsequent Tests.—Naturally, some anxiety was felt when all the animals in milk (or due to calve within six months), which had passed the test in the autumn of 1922, were due for re-testing in the spring of 1923. Of the 36 animals re-tested only two had to be rejected. A subsequent re-test in the autumn of 1923 showed again only two reactors, and this time out of 54 animals originally passed in 1922.

In view of the comparatively heavy infection at the beginning, the results of the subsequent re-tests may be considered satisfactory.

It would appear that the presence of even so small a percentage of reactors among animals which had passed the original test must be accounted for in one or another of the following ways:—

(i) Even the most searching test is not infallible.

(ii) The animals were infected from the buildings, or as is most likely, infection had already taken place at the time of the first test, but was of too recent occurrence to induce a reaction to inoculation with tuberculin.

Milk Yield and Health of Reactors and Non-Reactors.—As has already been stated, the immediate effect of the test upon reacting and non-reacting animals was sufficiently marked to cause notice, and a comparison of the subsequent health of the two classes of animals is instructive. Observation suggested that the non-reacting animals carried more flesh for the same quantity of food than did the reactors, and this in turn suggested that the non-reactors might yield richer milk than that given by reactors. In order to determine whether this was so, a comparison of milk yields and butterfats was made between the first 11 animals in the non-reacting herd, and 11 reacting animals of a corresponding age, and period of lactation, with the result shown in Table 2.

Table 2.—Comparison of Butterfat and Milk Yield, June 17th, 1923, to January 7th, 1924.

Non-Reacting Cows.

No. of Cows.	Born.	No. of Calves	Last Calf.	Butter-fat. per cent.	Tests.	Milk Yield.	Days	Average Daily Yield.
						lb.		lb.
1	5. 1.1919	2	9.12.1922	4.066	6	6,012	168	37.7
2	15. 8.1919	1	1. 8.1922	3.9	6	4.001¼	204	19.6
3	12.12.1919	1	24. 7.1922	4.525	4	2.521¾	81	30.0
4	17. 3.1919	2	8. 3.1923	4.137	8	3,186½	204	15.6
5	7. 9.1919	1	28.12.1923	3.875	8	6.902¾	204	33.8
6	15. 5.1920	1	12. 1.1923	4.5	6	2.708	169	16.0
7	21.11.1919	1	15. 1.1923	3.825	1	2,398¾	148	16.2
8	6. 5.1920	1	2. 2.1923	3.633	6	3.799	169	22.4
9	16. 9.1919	1	6. 2.1923	3.616	6	4.825¾	204	23.6
10	28.10.1919	1	5. 3.1923	3.566	6	5,631	204	27.6
11	17. 4.1920	1	3. 5.1923	3.45	8	6,276	204	30.7
			Average	3·917	—	—	—	21·6

Reacting Cows.

No. of Cows.	Born.	No. of Calves	Last Calf.	Butter-fat. per cent.	Tests.	Milk Yield.	Days.	Average Daily Yield.
						lb.		lb.
1	23. 6.1919	2	25.11.1922	3.23	10	4.786¾	204	23.4
2	1. 8.1919	1	5. 8.1922	3.68	10	1.325	204	21.2
3	11.11.1919	1	29. 7.1922	3.925	8	4.467½	175	25.5
4	19. 2.1919	2	23. 2.1923	4.32	8	3.772½	201	18.4
5	2. 9.1919	1	7. 1.1923	3.37	10	6,204	201	30.4
6	19. 4.1920	1	24. 1.1923	3.812	8	3,971¾	176	22.5
7	14. 8.1919	1	4. 2.1923	3.25	10	6,670½	201	32.7
8	21. 2.1920	1	2. 2.1923	3.266	6	1,753	161	28.9
9	9. 8.1919	1	25. 1.1923	3.908	12	4.047	204	19.8
10	6. 8.1919	1	13.12.1922	3.442	8	5.219¾	167	31.2
11	21. 2.1920	1	19. 1.1923	4.24	10	5,162	204	25.3
			Average	3·676	—	—	—	25·298

The fact that the reacting cows over the period under review show a slightly higher daily average milk yield than the non-reactors is no criterion. As a matter of fact, taking all the animals throughout the year the non-reacting animals by no means lower the average of the rest. On the other hand it is not intended to suggest that a non-reacting cow will yield more milk than a reactor, except that in the long run she will probably last longer.

One striking comparison between the reactors and the non-reactors has impressed itself strongly upon the writer's mind, and has greatly increased his confidence in the efficacy of the test, and that is the remarkable freedom of non-reacting

animals from minor ailments. During the past eighteen months no cases of chills, indigestion, stoppage, garget, milk fever, or repeated returning to the bull, have occurred in the "free" herd. Retention of the foetal membrane, with all its attendant troubles, a more or less frequent occurrence among the reactors, appears to be a thing of the past. Finally, the after-effects of calving among the non-reacting animals are almost negligible. No matter how high the condition before calving the majority of reacting cows, as soon as the calf is removed and the serious business of heavy milk production begins, appear incapable for many weeks of preventing the wasting of their own bodies at the expense of the milk pail. The non-reacting cows, however, appear not only to suffer less from the actual strain of calving, but are able to maintain their "bloom" without restricting their flow of milk.

Disposal of Reacting Stock.—The results obtained from the original test in 1922 created two very serious problems, namely:—

(i) The disposal of the reacting animals.

(ii) The rearing of tuberculosis-free calves from reacting animals whose stock it was desired to retain in the herd.

The first problem was solved by a very thorough clinical examination by the veterinary surgeon. All animals with suspicious udders or showing clinical signs of tuberculosis were immediately drafted out, and sent to the knacker.

Rearing Calves from Reacting Cows.—The second problem proved extremely difficult to solve owing to the surprising lack of authoritative information on the subject. The first step taken was to remove from the calf pens all the heifer calves which were under six months old, and which, consequently, had not been subjected to the test. The pens were then thoroughly scrubbed, disinfected and lime-washed. At the same time additional pails were purchased, and were used for calf rearing only.

It was next decided to take away all heifer calves at birth from their (reacting) dams, and to feed them on either whole milk from the non-reacting animals, or boiled milk and cod liver oil, the former from the reacting cows.

This experiment, besides being in great disfavour among the cowmen, proved highly unsatisfactory. Although several calves were reared in this manner, the majority of them, especially the smaller and weaker ones, developed on the

second or third day what was thought to be contagious "white scour." Two calves died in spite of unremitting care and attention, and post mortem examinations of these showed them to be victims of septicaemia. Two other calves, as soon as they showed signs of scouring, were put back on to their dams, and the scouring stopped within twenty-four hours.

This experience showed the inadvisability of witholding the colostrum from the calves, and appeared to be a practical confirmation of the view that the first milk of the dam confers upon the newly-born a power of resistance against bacterial infection.

After the lack of success described above, calves were left with their dams for four days, as had been the usual practice

Table 3.—Calf Rearing with Boiled Whole Milk and Cod Liver Oil.

Age of Calf.	*Food.*	*No. of Feeds.*	*Remarks.*
Birth till 4 days old	Dam's milk only	Ad lib.	The calf is left continually with the cow for the first 4 days. A certain amount of milk is drawn from the cow twice a day at the discretion of the cowman.
4th day to end of 4th week	8 pints of boiled whole milk daily containing 1 tablespoonful cod liver oil	3	*Hay and Rock Salt.* These are always in reach, only the best and "softest" hay being used. Calves will start licking the salt, and nibbling hay about the end of the 2nd week *Ingredients and consistency of Gruel.* 7 oz. of a mixture consisting of 7 parts linseed cake meal, 3½ parts whole linseed, 1 part locust bean meal are mixed with 1 gallon of water *Meal.* Calves are encouraged to eat a meal consisting of 8 parts linseed cake, 8 parts crushed oats, 6 split beans, 1 part fish meal, and are allowed up to 3 lb. per head of this at 9 months old
5th-8th week	4 pints boiled whole milk, and 4 pints gruel, containing 1 tablespoonful cod liver oil	2	
9th week	4 pints gruel	2	
10th-11th week	5 pints gruel	2	
12th-24th week	6 pints gruel	2	
25th-36th week	Gradually reducing quantities of gruel, and increasing quantities of meal, chaff, roots, silage or greenstuff	2 then 1	

in the herd, and were then taken to the calf pens, where they were fed three times a day on a diet of boiled whole milk and cod liver oil, which was gradually changed to a home-made gruel as they grew older.

The exact dieting of the calves from birth to the age of 9 months is given in Table 3.

At the age of 6-9 months the calves left the calf pens and were transferred to other farms to make room for new comers.

Up to date 96 heifer calves have been successfully reared in the above manner. The rearing of the calves has been entrusted to an old cowman, who from experience has now reduced the actual procedure to almost a fine art. The calves throughout have appeared to thrive and grow, and the glossy appearance of their coats (possibly produced by the cod liver oil) has often been remarked upon.

Two minor troubles only have manifested themselves. The first appeared when an attempt was made to substitute a commercial brand of cod liver oil for the more expensive pure medicinal oil. The calves steadfastly refused to take the former. On several occasions the sudden change from the dam's milk to the cod liver oil diet has caused scouring, but this has been found rapidly curable by the use of the latest proprietary internal antiseptic.

In the spring of 1923 the first six calves reared in the above manner were subjected to the tuberculin test, with the result that two out of the six reacted; of the next 33 tested in the following autumn, all passed the test. It should be noted that the two which reacted to the test in the spring were actually the first two calves reared on the lines shown in Table 3, and, consequently, at a time when the procedure was only in its experimental stage.

In the autumn of 1923 there were tested, together with 33 heifers reared on the cod liver oil method, 4 reared on the Grade-A method. These latter had been fed on milk from the "free" herd, and subsequently with gruel as in Table 3, and none of them reacted to the test. In order to demonstrate that the boiled milk and cod liver oil method of calf rearing is as good as the Grade-A method, the calves reared under these two systems were mixed together at the time of testing, and several independent judges were asked to distinguish them without success.

It may be argued that it was unnecessary to resort to the cod liver oil method when milk from non-reacting animals

was available. There were, however, three very valid reasons for its adoption. (1) The first was geographical—the Grade-A herd being nearly three miles from the calf pens. (2) There was a shortage of Grade-A milk, and an increasing demand for it had been acquired. (3) The chief reason was that the writer was anxious to obtain by the sale of Grade-A milk an immediate and tangible return for the money spent on the tuberculin test.

The results obtained so far with the calves leads the writer to hazard the following conclusions:—

(i) That it is quite practical consistently to rear non-reacting calves from reacting cows.

(ii) That there is comparatively little risk of a calf contracting tuberculosis by being left on its reacting dam during the first four days of its life, provided there is no unsoundness of her udder as far as can be ascertained by clinical examination.

Final Conclusions and Suggestions.—It would appear possible to build up in a comparatively short space of time a herd free from tuberculosis, provided that adequate and thorough preparations are made, and that each subsequent step is carried out with a rigorous attention to detail, both by the veterinary surgeon, and those in charge of the animals.

From experience gained with the large number of animals dealt with during the past two years, the writer would suggest to owners of pedigree herds, in order to save themselves anxiety, disappointment, disillusionment, and money, that the initial steps should start from the bottom (the calves) and not from the top.

In a herd the greatest infection and susceptibility coincide with the time of greatest stress in the animal's life, namely, from the time it actually enters the milking shed after dropping its first calf. It is reasonable to suppose, therefore, that a lesser degree of infection exists among the calves and young heifers.

Should encouraging results be obtained with these, the owner may be tempted to test his cows; if not, the latter should be left alone, and all efforts concentrated upon the progeny. The immediate separation of the non-reactors from the reactors, and the establishment of the former in buildings which have been thoroughly aired and disinfected, has proved successful in the writer's case; nor does there appear to be much fear of infection from pasture which has remained unstocked through a winter.

The danger of a "flare up," *i.e.*, the sudden reappearance of the disease among animals considered to be "free"—which has probably done more to discredit the tuberculin test than anything—can only be guarded against by the most scrupulous and skilled application of the test, and the most accurate interpretation of the results obtained from it. The veterinary surgeon, and all his helpers, should be informed that the goal is the creation, and the permanent establishment of a "free herd," not merely the thorough application of the Ministry of Health's regulations. Unless this point is particularly emphasised, the cowman, in his anxiety to ensure the retention in the herd of a favourite cow, may be tempted to employ any of the ill-conceived devices, which are all too well known. to achieve his object. By so doing, he not only thwarts the owner's efforts, but intensifies the already difficult task of the veterinary surgeon, and stores up prolonged trouble for himself. The veterinary surgeon, too, who errs on the side of leniency in order not to offend the susceptibilities of the owner, must expect to meet with disappointment when carrying out subsequent tests.

Two years may be thought all too short a time to judge as to the permanency of the results obtained in the case under discussion. The writer, however, accepts the results as the greatest encouragement to proceed on the same lines, even if there should be occasional setbacks—a possibility that is recognised but not anticipated.

Further, he wishes to emphasise the fact that in the above description he is dealing with the subject entirely from the layman's point of view. He does not wish to claim the introduction of anything startlingly new, but rather to set on record the results of two years' work, with the hope that it may act as a guide to owners of pedigree herds.

Apart from the public health point of view, he is convinced that the trouble and money expended have already been amply repaid by the improved general health of the animals in his charge.

* * * * * *

SOME POINTS CONCERNING PIG-KEEPING.

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During the past few years the breeding and feeding of pigs has probably received greater attention and aroused more interest than any other branch of farming, and if pigs have been kept on sound and economic lines they have returned a good rate of interest on capital invested in them. It is true that at the present time prices both for pork and bacon are comparatively low, and this has re-acted on breeding sows and young pigs, and the temporary depression has led to a tendency to dispose of breeding stock.

There is no branch of farming which fluctuates more than pig-keeping, and pig keepers, unless their work is combined with the production of other goods, must inevitably experience these periods of depression. An exceptional factor which has further tended to depress the price of pigs has been the large number of regulations which were necessarily enforced owing to the prevalence of foot-and-mouth disease. This has dislocated markets, and prices have consequently been low. Fluctuations in pig-keeping in the future, as in the past, are likely to continue, but possibly not to such a marked degree as hitherto if the movement to erect bacon factories continues. The present temporary depression does not indicate the possibilities, or even the probabilities, of pig-keeping when systematically carried out over a number of years.

Prices should not be judged on the returns from one year, but from a number of years. The pig keeper who has invested all his capital in pigs may not be in a position to wait for a favourable turn in the market, but at the same time it is not wise to commence pig-keeping unless allowance is made for these periodic depressions.

A number of small farms and holdings have sprung up, devoted almost solely to the keeping of pigs, and in most cases such holdings have consisted almost entirely of grass land. There has, perhaps, been a tendency amongst certain of those who have recently commenced to keep pigs to imagine that there is some "short cut" to success—that if they adopt the open-air system, or use feeding stuffs rich in vitamines, or include in their rations a number of mineral substances, they will be able successfully to run a pig farm. These are all factors of con-

siderable importance, but pig-keeping, like any other branch of farming, depends on a combination of these factors rather than a system which pushes any one of them to an extreme.

As far as is practicable, the different points in this article are based on the practice followed at the East Sussex County Council Farm at Plumpton, and on observations made on other holdings where a number of different systems of pig-keeping are followed.

Fluctuations in Prices.—With stock capable of increasing with such rapidity as pigs, prices must inevitably fluctuate over wide limits; but, apart from the usual seasonal variations experienced, if the total sales and receipts are kept over a period of years, it is surprising how consistent they remain. As an example, the sales at the East Sussex County Council Farm during the year 1920-21 amounted to £1,484, the following year £1,931, and the following year £1,726. During that period approximately the same number of breeding sows were kept, so that the total receipts over a 3-year period are very consistent. For consistency they compare quite favourably with the returns from a herd of milking cows, and more than favourably with the returns from the corn produced and potatoes grown. During the year 1922-23 accurate accounts were kept of the amount and cost of food utilised. The cost was £1,279, and was made up as follows:—

		£	s.	d.
2 tons 5 cwt.	Maize Meal	19	8	1
1 „ 15 „	Maize Gluten	16	3	9
4 „	Butter Beans	1	16	1
68 „ 6 „	Sharps	546	8	0
7 „ 3 „	Meat Meal	116	3	9
10 „	Wheat	4	0	0
41 gal.	Cod Liver Oil	7	17	2
2 tons 3 cwt.	Fat	63	11	4
3¼ „	Fish Meal	3	8	3
17 „ 7 „	Mangolds	13	0	3
36 „ 11 „	Barley Meal	383	15	6
	Greenmeat	0	10	0
26 „ 12 „	Potatoes	66	10	0
16 „	Dried Yeast	10	2	0
2½ „	Palm Kernel Meal	0	18	9
3840 gal.	Whey	16	0	0
1 doz.	Patent Food	0	1	10
2½ cwt.	Dried Milk	6	0	0
36 churns	Separated Milk	3	12	0
		£1,279	6	9

It was found that the work relative to pig-keeping necessitated labour equivalent to 1½ men. It should not be assumed, how-

ever, that the difference between the cost of food and labour and the sales is an indication of the profit which may be made. Although during the period the capital value of the herd increased considerably, it is quite possible that during a year of depressed prices the sales may barely meet the expenditure.

Open-Air Pig-Keeping.—It has been pointed out that no one factor in pig-keeping is likely to ensure success, but there is little reason to doubt that there has been no single factor of greater importance during recent years in connection with the breeding and feeding of pigs than the increased tendency to give them a more natural open-air life than formerly. At the same time it may not be desirable always to adhere solely to this system. On the average farm or holding where buildings and sties are available, it would be uneconomic not to utilise them fully. Beginners at pig-keeping are usually more successful when breeding and rearing on the open-air system than when using sties. Fresh air and sunshine are, of course, as vital to the pig as to any other class of farm animal, and the outdoor system makes these essentials more easily accessible than does a system dependent on the use of sties. Again, the open-air system usually enables pigs to obtain green food and incidentally those elusive substances, vitamines, which have loomed so largely in the pig keeper's mind during recent years. At the same time mineral matter, often deficient in the ration of the sty-fed pig, is usually easily obtained by pigs running in the open air. Fig. 1 shows a herd of breeding sows run on the open-air system at the County Council Farm, Plumpton.

Pig-Keeping in Woods.—This system has recently, and possibly more in East Sussex than in many counties, been largely practised, and its success justifies the contentions advanced by those who advocate it. It is, of course, reasonable to expect that a system of pig-keeping which so nearly approaches the natural conditions of the ancestral animal should be successful.

The most important argument to be urged against this system is undoubtedly the loss of manurial value of the food. The value of pig manure is widely appreciated on the farm and its loss amongst the underwood is a factor of no small importance; but on the other side the factors in favour of keeping pigs in woods are so great that in the writer's opinion they overweigh the loss of manurial value. From observations at the County Farm and elsewhere, he is strongly of opinion that, other conditions being equal, pigs having a moderate run of woodland are invariably healthier and do better than those kept in other

FIG. 1.—Groups of Sows at the East Sussex County Council Farm, Plumpton, run on the open-air system.

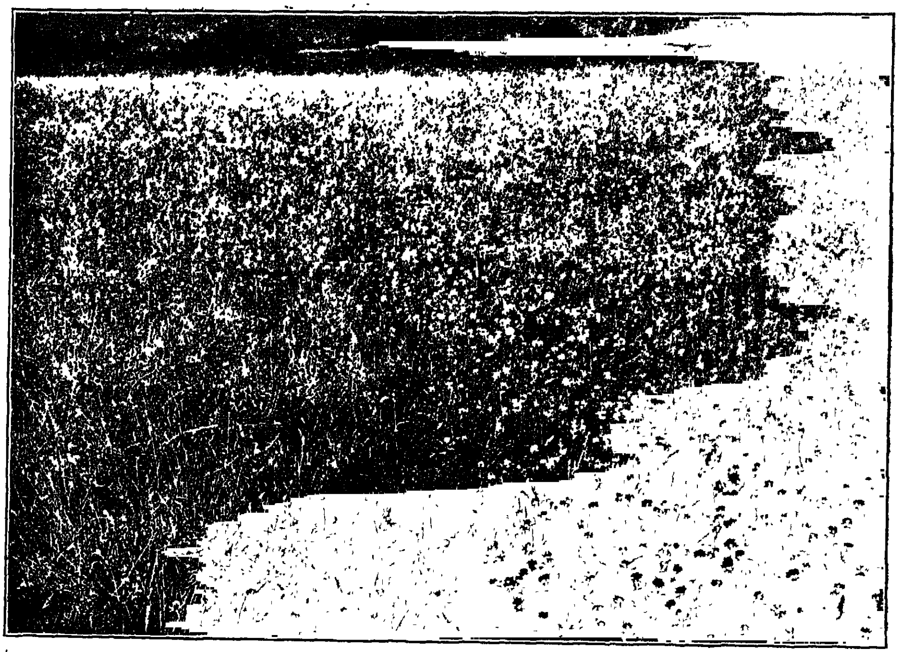

FIG. 2.—Poor Grass Land improved by Basic Slag on the right, untreated on the left. The growth of White Clover coincides exactly with the track of the manure distributor.

Fig. 3.—A group of Gilts before farrowing.

Fig. 4.—The same Gilts with their litters before weaning.

conditions. The shade afforded in the summer and the equable temperature prevailing are factors of the very greatest importance, whilst during the winter period the shelter afforded by the wood induces pigs to leave their houses when but for this shelter they would remain in their huts or hovels.

Again, in the woodland there is no necessity to ring the pigs, so that they obtain a considerable quantity of mineral and protein matter. On the other hand a number of novices have wrongly imagined that pigs kept in woods find there the greater part of their food. They may do so under exceptional circumstances for a very short period during the autumn months, but if success is to be obtained from this system regular rations must be provided. It is most interesting to note that, although the acreage of wood in question is small, there is very little tendency indeed for the pigs to wander from it. Other than the natural fence, no fencing of any kind or description is used. The gilts and sows lie in an open hovel and have free access to the wood. It is considered a matter of importance after gilts and sows have farrowed, if they have been kept on this system, to restrict their range shortly after farrowing, otherwise the young pigs do not seem to obtain a regular supply of milk, and suffer in consequence. It is also desirable for the sows or gilts to farrow in a shed and not in the wood.

Pig-Keeping on Restricted Areas of Grassland.—Although the pig is an animal which can utilise rough poor land, it is a mistake to think that pigs do not appreciate and benefit from good grassland, and the better the grassland and herbage the better will be the breeding sows and their offspring. The writer has invariably found that on grassland which has been improved the breeding stock do not need any addition of mineral matter and thrive well on a balanced ration provided that the necessary amounts of protein, carbohydrates and fat are available. Undoubtedly mineral matter plays a most important part in connection with the rearing of young stock, and there is no cheaper way of supplying it either to pigs or other stock than by a dressing of slag and kainit on pasture land. Fig. 2 shows part of a field which has been improved, and it has been found that the improved parts are as attractive to pigs as to any other class of stock.

On a number of small holdings devoted almost entirely to pigs there is often a considerable waste of grass and also of

the manure produced by the pigs. Liming of such enclosures does not seem to benefit them so much as might be expected. It appears to render the nitrogen from the manure more easily available and to encourage, rather than to check, the rankness of such over-stocked pig land. On the other hand a dressing of slag and kainit undoubtedly tends to check this rank growth.

The degree of immunity of pigs to diseases associated with dirty conditions is proverbial, but it is certain that much of the loss amongst sty-bred pigs is due to such diseases, and it is a matter of no small importance for the pig-keeper on a restricted range of grass land to consider how long it will be before these restricted areas become "sick of pigs." Unless they are improved by the addition of mineral matter they undoubtedly tend to become deficient in minerals, and must almost certainly become infested with parasites of various kinds.

In the County of East Sussex many thousands of Romney Marsh sheep are brought inland from the Marshes. They are renowned for their hardiness and their value for utilising rough grass land. They feed well on grass land where pigs have been run, and it is undoubtedly a most economic combination to stock such grass land with sheep during the winter months.

Sty Feeding and Breeding of Pigs.—In the western counties on dairy farms sty-feeding and breeding of pigs has been practised most successfully for years, indeed it is doubtful whether for practical fattening purposes a more ideal system could be found than the sty-feeding of pigs on whey and barley meal. This ideal combination of food has undoubtedly helped to produce much of the famous Wiltshire bacon, and generally on such dairy farms where dairy by-products are available, many of the difficulties experienced in connection with sty-fed pigs do not arise. Dairy by-products seem to supply the necessary mineral and other matter, so that it is chiefly on the cottage holding and on the farm where dairy produce is not available that sty-fed pigs thrive least. It is undoubtedly more difficult to rear and breed pigs when confined to sties than when kept on the open-air system, but the writer is still of opinion that sties, where available, should be used, though the rations fed to such pigs must be more varied and of a more generous nature than those fed to pigs running in the open.

Condition of Gilts and Sows Before Farrowing.—There appears to exist amongst a wide class of pig breeders an idea that breeding pigs should be kept in what is popularly termed "store" condition before farrowing; but it does not generally

seem to be appreciated that if the best results are to be obtained from breeding sows they must be in such a condition as to enable them to produce an abundant supply of milk for their litters. Fig. 3 shows a group of gilts at the County Farm, Plumpton. A number of pig keepers were of opinion that they were in too high a condition, but results and not opinions should surely be the guiding factor in deciding such a question. Seven gilts were farrowed down, including those shown in the illustration. They had all been similarly fed and were in identically the same condition. The 7 gilts farrowed down during the winter months were not supplied with any dairy by-product, and successfully reared 50 young pigs. Fig. 4 shows the gilts with their various litters just before weaning. It will be noted that despite the winter season the young pigs are big, alert and vigorous, and considerably above the average size of such pigs usually reared during the winter. There is no more wasteful form of pig-farming than to keep sows and gilts in an under-fed condition. It is useless to imagine that generous feeding after the young pigs are born can remedy insufficient nutrition before farrowing. It is of the greatest importance, however, that the condition shall be that of "fitness" rather than of "fatness," and that the ration used should contain a high proportion of protein. Owners of heavy milking cows do not generally allow their dry cows to get into "store" or poor condition; they realise that if high records are to be obtained the cow must be in good condition before calving. The same undoubtedly applies, but has not been generally recognised, in connection with pig-breeding and feeding. The ration generally used on the County Farm for in-pig gilts consists of 10 per cent. of meat meal, 60 per cent. of sharps, and 30 per cent. of barley meal; and although a large number of other rations and combinations have been tried it is still considered to be one of the most economic and satisfactory rations that can be used, always provided that the ingredients are of good quality.

NOMENCLATURE OF GRASSES AND CLOVERS.

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A CONSIDERABLE amount of confusion occurs as the result of the numerous descriptive terms that are often applied to grasses and clovers. It is much to be desired, therefore, that the terms in common use should be reduced to a minimum, and that these terms should be defined as accurately as possible, and each only used in its proper connection.

It is the purpose of this article to endeavour to give as precise a meaning as possible to those terms which it is desirable should be retained and generally used.

Nationality and Strain.—The majority of grasses and clovers, being cross-pollinating plants, do not attain to the same state of purity as crops like oats and wheat. It is none the less a fact that seed obtained from any particular source is likely to give rise to plants which, although differing widely amongst themselves, in the aggregate do conform to some general group characteristic. Thus the herbage produced on a plot sown with one lot of seed may have quite different general characteristics from that developed on a plot sown with another lot.

It is customary to speak of a group of plants conforming to some general characteristic as constituting a strain, and it is in this connection that "strain" has come to be applied to grasses and clovers. Thus "strain" does not imply the same high state of purity, or the ability to breed absolutely true, as the term "variety" in wheat or oats.

The "nationality" of a sample refers to the country where it was grown for seed, and as applied to herbage plants must not be taken necessarily to have any profound significance. It so happens, however, in the case of red clover and of several grasses, *e.g.*, cocksfoot, that seed grown in certain countries does tend to give rise to plants conforming to certain salient characteristics which can be definitely anticipated. This is true in a marked degree of Italian red clover, American mammoth red clover—and indeed of most of the nationalities of red clover, and of Danish, French and New Zealand cocksfoot.

In these cases "nationality" and "strain" are practically synonymous, and hence of course the importance and value to the farmer of the nationality clause in the Seeds Act.

It has come about also that local strains have been given district names. We hear, for instance, of Hampshire sainfoin, Montgomery red clover, Oxfordshire red clover, Vale of Clwyd red clover and the like, and all that is definitely implied (and practically guaranteed) by such descriptions is that the particular parcel of seed so referred to was grown in the district stated. The point here to be emphasised is that descriptions such as the above do not necessarily imply a guarantee of any sort as to strain. The Hampshire sainfoin might be giant French "once-grown," or it might be a fine and persistent strain of "old English." The Montgomery red clover might be Chilian seed "once-grown" in Montgomery, or it might be a fine extra late and persistent strain grown for generations in Montgomery. We see then that locality descriptions may mean everything or nothing as to "strain," and it should become customary to qualify the locality description by the description of the strain which the parcel of seed represents. It will, therefore, be desirable to endeavour to give a description of those strains of the chief herbage plants which are at present commercial commodities, and to select from amongst the numerous descriptive phrases in common use those which are the most applicable and definite in their meaning.

First, however, it is necessary to settle what certain of the descriptive terms should mean, viz.: "stock seed," "wild or indigenous," and "harvest year."

Stock Seed.—In the production of the seed of roots and vegetables great precautions are usually taken to ensure the purity of "stock" seed—that is to say of the seed which will be employed to sow the larger area for the production of pure seed for distribution.

It is unfortunate that in so far as grasses and clovers are concerned but little attention has been paid in the past to the question of stock seed. The term may, however, be used in the same sense as when applied to roots and vegetables.

Wild or Indigenous.—The terms "wild" or "indigenous" as applied to seed have been used to indicate that the seed has been harvested from old permanent grasslands or from waste places.

The term "wild" as applied to white clover has been in use for a number of years, and it is now generally realised that wild white clover is a definite strain. Wild red clover is also to a limited extent a commercial commodity. Quite recently wild or indigenous cocksfoot and some other wild grasses have also found their way on to the market.

A distinction has been made between ordinary wild white clover and "once-grown" wild white clover, and this is a distinction that should always be adhered to by vendors and insisted upon by purchasers, the more so since "wild" seed of sundry grass species is taking its place alongside wild white clover. "Wild" as applied to seed has been taken to imply, and should only be applicable to, seed actually harvested from old permanent swards or from waste places. The term as thus defined has a very real strain significance and indicates that the seed is likely to give rise to plants which will be far more persistent and aggressive under conditions of competition than non-wild seeds.

"Once-grown" wild seed is seed that has been harvested from a ley sown down with stock seed obtained direct from an old permanent sward. Seed harvested from such a ley and again sown to develop a seed-producing ley would give rise not to "once-grown" but to "twice-grown" seed. The term "once-grown" is therefore only applicable to the direct and first generation progeny of permanent sward seed, but unfortunately the term is by no means always used in this correct sense, "twice-grown" or "three-times grown" seed being on occasion referred to as "once-grown" or sometimes even as "wild"!

In this connection the writer would suggest the desirability of the word "wild" only being used to refer to seed actually harvested from old permanent swards, and "indigenous" being used when supplies of seed derived from an "indigenous" stock are developed by a process of growing on. Thus wild white clover would retain its definite meaning and would be applicable only to old sward seeds. "Once-grown" wild white clover should then be referred to as "*once-grown*" *indigenous white clover*.

In the case of grasses like cocksfoot the wild or indigenous seed on the market will seldom, if ever, have been taken direct from old sward or waste places, but will always have been once or more grown on. It should therefore be referred to as "indigenous," "once-grown," "twice-grown," etc., as the case may be.*

This would be a valuable distinction in the case of perennial ryegrass—the seed cleaned from wild white clover harvested in Kent would legitimately be described as "wild perennial rye-

* The above distinction between "wild" and "indigenous" would be valuable even if "indigenous" were taken merely to imply "grown on" without any qualification as to the number of generations.

grass," while that grown on from selected indigenous stocks would be "indigenous perennial ryegrass."

NOTE.—The evidence so far available suggests that there can be little or no objection to "growing on" wild seed—provided reasonable precautions are taken to isolate the growing-on leys—and (or) by methods of control to bring them to flower at a different date to adjoining fields.* It must be remembered, however, that old sward conditions will have made for a selective influence in favour of plants of marked persistency, while the taking of seed from young leys tends to exert an influence in the opposite direction.† It is therefore very desirable that "once-grown" seed of a persistent plant like wild white clover or a persistent indigenous strain of rye grass or cocksfoot should not be taken in the first harvest year—but always deferred until the second or, preferably, the third or fourth harvest year—and that stock seed should always be obtained from an old sward in the case of "wild" plants, and from carefully isolated and re-selected stock seed areas in the case of "indigenous" plants. Thus "once-grown" wild seed is always to be preferred to "twice-grown," and the same is true of indigenous seed, unless there is some very definite assurance that the methods of seed production employed have been based on sound scientific principles.

Harvest Year.—The "harvest year," *i.e.*, year in which seed is taken, is of great importance, not only in the case of the persistent wild strains but also in the case of other persistent strains—such as old English sainfoin and the late-flowering red clovers. In the opinion of the present writer stock seed of old English sainfoin and of the more persistent late-flowering red clovers should always be taken from leys that have been down for the greatest possible number of years, and, when possible, seed for distribution should be taken subsequently to the first harvest year.

It is urged that it should become a common practice to refer to the harvest year in the descriptions that accompany seeds for sale. The writer would be prepared to give more per pound for seed of once-grown indigenous white clover harvested in the third harvest year than for seed from the same ley harvested in the first harvest year, and more for Montgomery red clover harvested in the second harvest year from stock seed off a ley four years old than for Montgomery red clover harvested in the first or even the second harvest year from stock seed harvested in a first harvest year.

There can be little doubt that as the question of strain and methods of seed production in relation to strain become better

* Wild White Clover and Indigenous grasses normally tend to flower later than their commercial counterparts.

† See also Stapledon, R. G.: Strains of Herbage Plants, in the Year Book of the Essex branch of the National Farmers' Union, 1924.

understood, there will be an increasing demand for "once-grown" seed, not only of indigenous white clover but of numerous indigenous grasses, and that those farmers who take the wisest precautions to safeguard the purity of their stocks will obtain the best prices for their seed. The purchasers, however, should be informed precisely what those precautions have been, as applied both to the seed of distribution and to the stock seed.

Definite Strains of Herbage Plants.—Apart from the distinctions between wild white clover and white or Dutch clover which are now generally realised, and the important distinctions that can be made in respect of red clover, at present "strain" has not attained to great significance in relation to herbage plants. It is evident, however, that the time is not far distant when various strains having definite properties will be available in the case of numerous species. It is much to be hoped that such strains when made available will be accurately defined in terms of important agricultural properties such as persistency, leafiness, suitability for hay or pasture conditions, and the like. The need for clear definition devoid of all ambiguity is well exemplified by the confusion that obtains relative to red clover, concerning which species the following notes may be found useful.

Red Clover.—The cultivated red clovers fall into two groups—the early-flowering and the late-flowering. These two groups are as distinct from each other as are winter and spring oats, and each group contains a number of more or less clearly defined strains. All cultivated red clovers should be referred to as either (1) broad red (=the early red clovers), or (2) late-flowering red. Late-flowering red clover is often known as single-cut cowgrass, but since "cowgrass" is frequently used with reference to broad red clover it would be a great gain if the ambiguous word "cowgrass" could be entirely dropped, when such descriptive terms as "giant hybrid cowgrass," also meaningless, would fall into disuse.

It is not necessary here to give detailed particulars of the various strains of broad red clover and of late-flowering red clover.* It may be stated, however, that the former group constitutes those strains which are more definitely biennial, flower early, aftermath well, produce a considerable amount of keep in the autumn of the seeding year and come into luxuriance com-

* See Stapledon, R. G., and Williams, R. D., "Red Clover," this *Journal*, Vol. XXX, p. 239; Williams, R. D., "Red Clover," Bull. H. No. 1, Welsh Plant Breeding Station; and Williams, R. D., "Strains of Red Clover," a Paper read at the Aberystwyth meeting of the Agricultural Education Association, see Agricultural Progress, Vol. I, 1924, p. 50.

paratively early in the spring of the first harvest year. They are not as a rule persistent. The late-flowering group consists of those strains which flower late, do not aftermath as well as the broad reds, produce less in the autumn of the seeding year and start growth later in the spring of the first harvest year. They are, however, more persistent than the broad reds. Certain strains are extra late to flower, extra close growing in the early spring, and exceptionally persistent. Such a strain is, for instance, the Montgomery red (using "Montgomery" in the strain sense). A strain of this sort should therefore be described as "Montgomery extra late-flowering red clover," if the seed was harvested in Montgomery; while if the seed in question had been grown in Essex from stock seed obtained from Montgomery it should be described as "Montgomery extra late-flowering red clover once-grown in Essex," and particulars as to the harvest year of both the stock seed and the distribution seed added.

In conclusion, it seems desirable strongly to urge farmers, seed growers and seed merchants alike to insist upon the adoption of a standard nomenclature as applicable to seeds, methods, and places of seed production, for unless this is done the confusion will become intolerable, and the benefits resulting from the production of relatively pure and improved strains will be largely lost to the agricultural industry as a whole.

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AN EDUCATIONAL EFFORT AT AN AGRICULTURAL SHOW.

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IN view of the preparations now being made by agricultural societies for the show season, it may perhaps be useful to give some account of an effort made by the Three Counties Society last year, at their show at Malvern, to interest the rising generation in the importance of agriculture to the nation.

Arising from a chance suggestion made at a meeting by the Hon. Mrs. Wilmot, of Earl's Croome, near Worcester, who is herself a keen agriculturist and a practical and successful small holder, the Council of the Society offered to give facilities for the attendance of children from the elementary schools in the Three Counties (Gloucestershire, Herefordshire, and Worcestershire), provided that they were accompanied by their teachers, and that some effort was made to make the visit instructive as well as entertaining. The result was as interesting as it was unexpected. It was thought probable that perhaps 200 or 300 children would

attend, but no fewer than 1,000 children from 13 schools, mainly of course in the neighbourhood of Malvern, attended the show in this way.

Careful preparations were made for their reception and instruction. In the first place, the approval and co-operation of the County Council and of the Board of Education were sought and readily obtained. After a discussion of the matter with the Inspector of the Board of Education, a proposal was submitted to headquarters to the effect that the visit should be allowed to count as school attendance, and this proposal was approved. This is a matter of no small importance as it makes much difference to the outlook of the teachers and of the county authorities with regard to such a visit, having in view the education grant. At the same time the County Director of Education was consulted, and he readily gave every facility for the necessary organisation from the County Council standpoint. He kindly arranged for a meeting of the teachers who had signified their willingness to attend the show and bring their children, and in other ways made matters easy for the society's representative to whom the work of organisation was entrusted. The latter met the teachers and gave them particulars of the proposed programme to be followed and of the general idea in the mind of the council as to the working of the scheme and the instruction of the scholars.

This meeting was well attended and evidently greatly appreciated by the teachers, to whom the idea was entirely new, and some of whom were not well versed in agricultural matters. Further, a detailed itinerary was drawn up, with short notes upon the matters of interest to be specially noted at the various places to be visited. Thus in turn the children were taken to see the stands both of the local and of the more widely known dealers in and makers of farm implements; this was followed by a visit to the very interesting exhibits of the Malvern Public Health Committee and the Women's Institutes. The flower show, working dairy, seed, cake and manure firms followed; a glimpse was afforded of the opportunities offered overseas by the Canadian Government, and then the groups of children went on to see the stock.

With regard to the latter, brief descriptions of the principal purposes of the breeds exhibited had been prepared and printed and put up at the ends of the sheds, and each teacher was provided with a copy of these particulars. It may be of interest to quote one or two examples :—

HEREFORDS.—A beef breed, classed with the black Aberdeen-Angus as the best for that purpose. The young cattle come to maturity very early. Hardy, and very popular in America (North and South), South Africa and Australia.

SHORTHORNS.—There are two types—the beef and the dairy Shorthorn—and this is thus a dual-purpose breed. The vast majority of ordinary cattle in England are cross (or partly-bred) Shorthorns. Largely exported to North and South America.

JERSEYS.—Share with the Guernsey the pride of place as a butter producer. A native of the Channel Isles, where the normal stock varies from 11,000 to 12,000 head. Very popular everywhere that climate suits. The milk contains a common average of 6 per cent. butter fat. Much hardier than commonly supposed.

DEXTERS.—The smallholder's cow. These wonderful little cattle are about as hardy as goats, and the best of the breed are excellent milk producers. The smallholder and the farmer with poor grassland should give consideration to this breed. The cows cross particularly well with other breeds for beef or milk production.

It was not thought desirable to limit in any way the time which the children should spend at the show, because it was felt that they would be disappointed if they had to leave before the usual show-ring attractions took place. Their attendance was, however, confined to the second and third days, with a view of keeping the ground free during the judging day. It was felt by the Council that some charge ought to be made, and they fixed the amount at 3d. per head, provided that tickets were applied for and obtained beforehand, so as to avoid crowding at the turn-stiles. The teachers themselves were presented with complimentary tickets.

There is no doubt that the whole experiment was thoroughly justified by its success. As has already been mentioned, over 1,000 children attended, and that they really learnt something was put to the proof by the private offer by the Society's representative who organised the visit, of prizes of one guinea and half a guinea for the best essay on the Importance of Agriculture to England, open to scholars who attended the show. Each teacher was asked to submit the best one or two of the essays written by his or her pupils, and these picked essays were then sent to the donor of the prizes for final adjudication. They were extraordinarily well done and clearly showed that the teachers had spent both time and trouble in bringing home to their scholars the lessons to be derived from their visit to the show. Permission was obtained to publish the prize-winning essays, and one is reproduced here.

The first prize was won by Dorothy Davies, aged 13, of Leigh Sinton School, whose essay was as follows :—

"Agriculture is the oldest industry in the world and at present the most important. Right up to the middle ages, agriculture formed the chief occupation of the people, every man growing enough for himself and his family. But when manufactures came to England, factories and towns sprang up and people left the villages to go to the towns, leaving less people to cultivate the land, but swelling the number that needed the country folk to supply food for them. People still leave the villages every year, and the population of the countryside is decreasing, so that we find the majority of England's people in the towns.

Yet, do these town-people consider, when they come to admire the beauties of the countryside at holiday-time, that they owe all they have to the country and the farmers, that their clothing, food and shoes came in the first place from the countryside? Do they think either that the raw materials for the factories they work in come from the farmers of England and other countries, and that the farmers are really the foundation of a great many industries? The wool and cotton and leather all provide raw materials for manufactures, and the animals and vegetables, fruits and corn, provide food for those who work at the manufactures.

But if the whole of England was laid out for agriculture and cultivated properly, it would not supply enough food for the needs of England's great population. Agriculture is not so simple as it looks, and men must study hard if they wish to know all about it. All farmers are not agriculturists, but they help to grow food for the townspeople. Some farmers found that last season the wheat did not pay back very well, and are not growing so much.

It can easily be said of England that she is one of the foremost countries in the production of good, fine, standard breeds of cattle, and her sheep are very fine, some breeds being unrivalled. Pigs and poultry, too, often gain high awards.

Just to show what can be done in these and other respects and to keep up the proud interest in agriculture and stock-breeding, shows are held and awards offered for the finest animals. To cultivate the land well and to be able to look after his animals a farmer must pursue the new and up-to-date methods that men are continually inventing, all to better agriculture, and he may learn those methods at a show.

Here men meet from all over the country to exhibit their machinery and animals and show their new methods One item of the Three Counties Show, given great attention, was clean milking, which showed great improvement on the ordinary method. It showed how to prevent the deaths of so many children from drinking unseeming, filthy milk, that was really full of germs. It told how a dairy should be kept, and expounded some men on the way they milked cows with their filthy hands.

At a show like this all the best of everything is exhibited. Farmers find new sorts of vegetables, new breeds of cattle, fresh kinds of poultry, and flower-fanciers invent different kinds of brightly-hued flowers. New inventions in the shape of machinery are shown, and other countries exhibit their produce on a small scale. At the Great Show a good deal about Canada could have been learnt by looking at a covered-over stall, called 'Canada's

Productions,' where everything grown in Canada was represented by a small piece of each.

Another thing that attracted many was a man lecturing on bees, who showed several hives of bees, and he himself was covered with them till he was hardly discernible.

I had never seen such beautiful cattle, sheep and pigs, poultry and goats, horses and flowers, as I saw there. Monstrous bulls and cows were shown, and the wool on some of the sheep was three or four inches deep, while others' wool was like fine silken hair that curled beautifully.

There were a great many other attractions, all interesting, and, on the whole, I am sure the show did a great deal of good, and besides interesting people taught them as well."

Two or three gems from the writers of unsuccessful essays are worth quoting. They were given in the *Worcester Herald* for 10th August, 1923. For example, one boy of 14 years wrote :—

"Nowadays the school children have a great many more chances to learn than their grandparents, or even their parents. When the children come running in and say that they are going to the Three Counties Show with the school, the old grandfather murmurs: 'We never had such treats in our time at school.' No! the educational point of view is different now from what it was in those days. Teachers of to-day think that their pupils can learn better if they see what they are being instructed about. If children see anything that interests them in their early life, they generally keep it in their mind's eye, and perhaps in later years try to improve upon it."

Another boy of 13 years wrote :—

"The modern farmer is an Atlas up-to-date, bearing the world upon his shoulders. He is head of the world's larder, always striving to keep it well stocked to meet the needs of a great community. He cultivates the soil, he gets good crops by careful selection of his seeds beforehand, and in various other ways helps on the work of agriculture. In the late Stone Age tools were scarce, and people were few; therefore, a barren wilderness resulted. The British Isles are surrounded by water, and they depend entirely upon the Colonies for food. The farmers do not grow enough to feed the nation."

Just a final quotation from the paper by a 12-year-old girl :—

"There was a lovely new geranium called Fascination, and it would be a funny world if God had not made any flowers."

In addition to the facilities offered to the elementary schools, somewhat similar opportunities were afforded by the Council to the scholars at the Malvern College and the many other large schools for which Malvern is famous. There are some 2,000 children attending such schools in Malvern, and the Council allowed the scholars to come to the show at any time at half

price. That this concession was appreciated was shown by the fact that at one time there were on the show ground no fewer than 500 boys from the College alone. Parties of these boys were organised at their own request, and they were taken round the ground by well-known agricultural experts, who took pains to make their visit of real value.

For the reassurance of show authorities who may contemplate following the Three Counties Society's lead, it may be mentioned, first, that a very substantial sum accrued to the Society in gate-money, and secondly, that never was there any trouble through over-crowding or otherwise as a result of the visit of the children.

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METHODS OF ORCHARD SOIL MANAGEMENT.

ERNEST M. BEAR.

PREVIOUS to the war the orchards of England, with very few exceptions, fell into two classes:—those under clean cultivation and those under permanent grass. These two main divisions still hold good, but the scarcity of labour during the war years, and its high cost since, have induced growers to make alterations in their methods of management. Many more orchards have gone down to grass, and various new methods of dealing with the herbage have been introduced. In most of the orchards which are still under clean cultivation new methods of tillage have been adopted for reasons of economy. In different orchards, both arable and grass, the systems of soil management are much more varied than formerly. The object of this article is to describe some of these systems, and to discuss their merits and their suitability to various conditions, climatic and otherwise.

Clean Cultivation.—Before the war the usual method of maintaining clean cultivation in orchards was to have the ground dug during the winter, and to follow this up throughout the growing season by horse cultivation between the rows of trees and hand hoeing in the rows. In the case of many plantations of bush-shaped or dwarf trees, planted too close together for horse cultivation, the whole of the work had to be done by hand. There is still no better system of cultivation; but in most cases growers have been obliged to find less expensive methods. The winter digging, or rather shallow forking over, used to be done

very cheaply by piecework, but is now naturally much more costly, even if men can be found willing to undertake it by the piece. Hoeing also, which must be done at frequent intervals during the growing season, if the land is to be kept clean, has become much dearer, so that growers are obliged to reduce to a minimum the area which can be worked only by hand.

New Implements.—Fortunately the situation has stimulated invention on the part of implement manufacturers. "Off-set" implements, such as have long been used in American orchards, have been introduced. These are so designed that they can work the soil under the branches, close up to the stems of the trees, whilst the horses and man walk clear of the branches midway between the rows of trees. There are, for instance, several patterns of fruit farm or plantation ploughs. These differ from an ordinary plough in having the head and handles adjustable, so that they can be swung out at an angle to the beam. The horses are attached by a single trace chain to a staple on the beam, and not to the head in the usual manner, the adjustable head serving merely as a guide and support to the trace chain. The breast is designed to turn a wide, shallow furrow-slice, as deep ploughing is neither necessary nor desirable amongst fruit trees. A disc coulter can be fitted in place of the usual knife coulter for ploughing grass land or where weeds are very thick. With such a plough it is possible to work right up to the stems of the trees, unless they are of the old-fashioned bush type, branching right from the ground level.

Ploughing in Orchards.—There are several ways of using the plough. The best is perhaps as follows:—If the land is weedy, first fork over by hand the narrow strip down each row on which the trees actually stand. Then plough towards the stems of the trees. This leaves a shallow furrow midway between the rows, which is useful for drainage. The following winter, in order to keep the land fairly level, plough away from the stems, and dig the narrow strip in the actual tree rows after ploughing. It is sometimes recommended that the land should be ploughed up to the trees in autumn and away from them in spring. This, however, doubles the labour, and involves more stirring of the soil with its risk of injury to the roots. Moreover, the second ploughing brings to the surface again any manure and weeds which were buried by the first ploughing. Still, the second ploughing is occasionally necessary after a wet,

mild winter in which the weeds have grown through the furrow seams and the land has been solidified by heavy rain and the trampling connected with winter spraying and pruning. Two ploughings are certainly not necessary for the sake of levelling the land. The summer work with cultivator and hoes does much toward this, and ploughing towards and away from the trees in alternate winters completes the process.

Whether the single ploughing should be done in autumn or in early spring is a matter which must be decided by local conditions. Land ploughed in autumn certainly lies drier during the winter. On the other hand, if the land is weedy, there is something to be said in favour of leaving the weeds as a cover crop to prevent the washing out of plant foods during the winter, ploughing them under in early spring. In practice, where there is much land to be ploughed, it is probably best to get the work done at such times during the winter as conditions are suitable and the horses are available.

Ploughing may not be essential every winter. When a dry autumn favours late surface cultivation, so that the land can be got clean before winter, it may be omitted, at any rate on some soils. It is unwise to do more ploughing than is absolutely necessary, as the less the roots are disturbed the better. It has been found that the greater part of the food-gathering roots of fruit trees lie between 4 in. and 10 in. below the surface. For this reason the plough should never go more than 3 or 4 in. deep. If this is kept to, it is doubtful whether ploughing does any more harm than shallow forking, and it certainly does less than deep digging.

Spring and Summer Cultivation.—Whether the land has been ploughed or not, surface cultivation should begin at the earliest opportunity after the soil becomes dry enough in spring. This does good at first by admitting air to warm the soil and start the processes which lead to the elaboration of plant foods; and, later in the season, a fine surface tilth or "dust mulch" does much to protect the trees from drought injury by checking the upward flow of moisture and its loss by evaporation from the surface.

For reasons of economy hand hoeing must be reduced to a minimum. Implements of recent introduction assist the grower in this direction. There are cultivators with adjustable head and handles, used in the same way as the plantation plough already mentioned. It is also a simple matter to fit a special disc rudder attachment to a spring-tined cultivator. Both types of culti-

vator have their uses, according to the condition of the ground; and both allow of the soil being stirred beneath the branches of the trees, leaving only very narrow strips to be hoed by hand. Indeed, where it is possible to cultivate in two directions hoeing may sometimes be avoided altogether. The spring-tined cultivator, which is very low, can be used even amongst bush-shaped trees which branch close to the ground.

Cultivation and hoeing are generally needed three or four times in the spring and early summer, and again a like number of times in the autumn, if the weather is dry enough. There is usually a period in the summer when cultivation is not much needed, and when it is undesirable on account of the branches being weighed down with fruit.

Many horsemen regard these newfangled off-set ploughs and cultivators as quite impossible tools. The writer can say from experience, however, that anyone can work them easily after a brief trial; and they make for the comfort of the man by keeping him clear of the branches.

Motor Cultivation.—Motors are used to some extent in place of horses in fruit plantations, and there is no doubt that they do much less harm amongst the trees. In Kent orchards small tractors are used to draw both ploughs and cultivators. Rotary soil-tillers are very useful for surface cultivation during the growing season, as they are narrow enough to pass between rows of bush fruits and low enough to work under branches about 3 ft. from the ground. Their chief value is to reduce hand labour, both digging and hoeing, rather than to replace horses where there is plenty of room for the latter to work.

Intercropped Plantations.—Most young orchards are intercropped until the trees grow large enough to shade the whole of the ground. If they are intercropped with vegetables, flowers, or strawberries, as is the custom in some districts, the cultivation must be such as is required by these crops, and need not be considered here. More generally, however, the young orchard is intercropped with bush fruits. In this case the space between the rows soon becomes too narrow for ploughing. It is better, in fact, to manage as far as possible, even from the start, with surface cultivation only, as bush fruits are shallow rooted. For a good many years a horse-drawn or motor cultivator can be got between the rows, and as long as this is possible there is no need for deeper tillage, though it is usually necessary to dig the actual rows. For a few years after planting, in fact, it is often possible to cultivate in two directions, in which case digging and hoeing

are confined to a small space round each bush and tree. The first cultivation in spring is often difficult, owing to the surface being panned down by the winter's rains. The writer knows nothing better in such conditions than a rotary motor tiller. It is possible, however, to do the work with a horse-drawn cultivator if suitable tines are fitted, those with chisel points being, perhaps, as good as any. Sooner or later there comes a time when the bushes fill the space so that horse or motor cultivation must cease, and there is nothing for it but to fork over the ground in winter and hoe it by hand in summer. By that time, however, the bush fruit should be yielding well enough to pay for such work.

Very thorough cultivation is, of course, essential for bush fruits, which quickly suffer from drought unless a mulch of fine soil is maintained during the late spring and early summer. Cultivation should start as early as possible in spring and be repeated whenever the surface tends to become either weedy or panned down. Nor should the work cease after the crop has been gathered, for a plantation which is not cleaned in the autumn by surface cultivation must be dug in winter to get rid of the weeds. By the time the bushes are worn out the permanent trees should be coming into full bearing. The bushes can then be grubbed and the orchard treated as described already.

Grass *versus* Cultivated Orchards.—As a general statement, it may be said that an orchard under clean cultivation is superior to one under grass. The fruit grows larger and is often of better quality, the flavour and texture of the flesh being more pleasing. This, however, is only a general statement. Much depends on the management of the grass orchard, also on local conditions of soil and rainfall. There is no doubt that a grass orchard is more liable to suffer in a year of drought. On the other hand, it is drier during a wet season and during the winter, which is an indication that grass is an advantage in a wet situation. There are circumstances in which grassing is harmful and others in which it is beneficial. If the trees are fruiting freely and not making any too much growth, grassing cannot be advised, as the trees are likely to go downhill. If, however, they are making vigorous growth, and particularly if they are making growth rather than fruit, grassing is likely to steady the growth and induce a more fruitful habit. Where leaf scorch is troublesome amongst apples, grassing sometimes proves a remedy. Though the fruit is generally smaller in a grass orchard than in one that is well cultivated, it invariably has a higher colour, particularly

in a wet season. Very often, too, it has better keeping qualities. It is an advantage to a grower to have some orchards under grass and others cultivated, as the two classes score in different seasons.

The kind of fruit grown has some influence. Plums are generally decidedly better on cultivated ground, whereas most cherry orchards are grassed. In the case of apples and pears, standard or half-standard trees on free-growing stocks are more suitable than bush-shaped trees for a grass orchard.

It is the question of expense, however, which has prompted so many growers in recent years to grass down their orchards. They contend that, even if the fruit is not always of such high quality, it pays better owing to the reduced cost of production. As a matter of fact, there are plenty of instances, under modern methods of management, in which the fruit is of superior quality in grass orchards in all but seasons of severe drought. It cannot be too strongly insisted, however, that an orchard must be well established before it is grassed down. Clean cultivation is essential for at least seven or eight years after planting, and better still for ten or twelve. Nothing is more prejudicial to the growth of newly-planted fruit trees than having turf over the roots, as may be seen from examples in every district. The trees simply stand still, and in most cases become permanently stunted and useless.

Management of Grass Orchards.—The oldest examples of grass orchards are composed of tall standard trees with stems 6 ft. high. The grass is kept short by grazing with sheep, and occasionally even with cattle. Provided that the sheep, during part of the year, receive cake or other concentrated food, the trees are considered to get all the manure they require, though there is no doubt that both the trees and the stock would benefit if such orchards were occasionally dressed with basic slag, steamed bone flour, or some other phosphatic fertiliser. The object in the best-managed orchards is to keep the grass short by grazing, this being particularly desirable during late spring and early summer, when the rapidly-growing herbage makes its heaviest draft on the moisture in the soil.

Pigs and Poultry in Orchards.—Orchards grassed down in recent years are seldom of the tall standard type, but more often contain half-standard trees or bushes on a short leg. Amongst these cattle are out of the question, and even sheep are seldom advisable. The stems of the trees can be protected with wire netting or by painting with a deterrent dressing; but even

then sheep will damage any branches which are within their reach. Many growers, therefore, now run pigs under their trees. Provided that they are regularly fed and watered, and are not kept until too old, pigs very seldom do any damage even to bush-shaped trees. If run thickly enough they keep the grass in check, and supply the trees with all the manure they require, unless it be an occasional dressing of phosphates.

Two methods of pig-keeping are to be seen. One aims merely at keeping the grass under control, the pigs being run over a fairly wide area. The other consists of penning the pigs thickly on a small space at a time, preferably a narrow strip, and moving them on when they have thoroughly worked the ground. This they quickly do so long as the soil is moist enough. In this way the orchard is really kept by the pigs under cultivation, though it may appear somewhat rough at times. The combination of pig-keeping with fruit-growing is being largely taken up, and it is doubtful whether there is any better stock than pigs to run in orchards, both for the benefit of the trees and from a financial point of view. If portable shelters and self-feeders are adopted the labour involved is not considerable.

Some growers prefer poultry in grass orchards. They can hardly be kept thick enough permanently to keep down the grass entirely. In some instances, at any rate, it has been found necessary to mow the herbage once a year and carry it off. This is a drawback, as it means a loss of organic matter. However, the poultry, kept at the rate of about 60 to the acre, are considered to supply the trees with all the manure they require. Poultry have one advantage over other stock in that they destroy a large number of insect pests, though their work in this direction is not sufficient to relieve the grower of the necessity for spraying. Fortunately the birds appear to be unaffected by the poisonous washes used, and need not be moved out of the orchard even when arsenate of lead is employed. Of the classes of poultry available, there is much to be said in favour of the light breeds of ducks, which do not require water for swimming and, if of good strain, are remarkably good egg-layers. One great advantage is that they are easily and cheaply confined by quite low wire netting.

The Sod Mulch System.—What is known in America as the sod mulch system does not appear to have been adopted in this country to any extent. It is considered there as being suitable for districts where the early summer rainfall is not likely to be short, and for land that is too hilly for clean

cultivation. So far as drought resistance is concerned, it occupies a position somewhere between clean cultivation and permanent grass kept down by live stock. The system consists of mowing the grass twice a year and spreading it evenly over the surface, where it forms a mulch for a time, and eventually rots and finds its way into the ground.

The writer has under his management an 8-acre apple orchard which has been under the sod mulch system for six years. It was originally sown with lucerne, the idea being to mow this two or three times a year, and so enrich the soil with organic matter and with nitrogen obtained from the air by the leguminous crop. The lucerne, however, did not last long, probably not caring for the shade of the trees. It has now almost disappeared; but the grass which has taken its place is still mown and left as a mulch. The soil is light and badly in need of organic matter, and for such conditions the sod mulch system seems to be well adapted. This orchard gives a very good account of itself, particularly in a wet season, but during the very severe drought of 1921 it undoubtedly suffered more than the cultivated orchards. Manures, of course, are required; and it may be considered a disadvantage that the bulk of these is used first by the grass, and is not likely to show prompt results on the trees. It must be remembered, however, that, when the grass mulch rots, as it soon does, the manures are returned to the soil in the organic form which seems to be almost essential for fruit trees. This would appear to be an inexpensive way of organic manuring. The comparatively cheap mineral fertilisers can be used entirely, and converted into organic form through the medium of the grass.

The Sod Strip Method.—Although the orchard just mentioned is doing well, one hesitates to do away with cultivation altogether in other orchards, because cultivation is so beneficial during drought, and prompt response can be secured from dressings of organic manures. A compromise is now being tried. The alleys between the rows of trees are ploughed and cultivated as described above under the heading "Clean Cultivation"; but the narrow strips on which the trees actually stand are left under grass, which is mown twice a year and treated as in the sod mulch system. In this way it is hoped to avoid altogether the expense of hand digging and hoeing, and to combine some of the advantages of both grass and cultivated orchards, whilst avoiding their drawbacks. The most active roots must be situated for the most part in the spaces

between the rows, where they receive the advantage of cultivation and manuring. Bulky manures can be ploughed into these strips, which, when cultivated, correspond to the fruit borders of a private garden. The grass strips, it is hoped, will be sufficient to give the well-known grass effect of added colour in the fruit, and possibly also to prevent leaf-scorch. As the system has been in operation for a year only, nothing can yet be said about results; but it is quite a recognised system in Canada, where it is known as the sod strip method, and is found to yield the results outlined above.

Cover Crops.—In most of the countries which send fruit to our markets it is the custom in very many orchards to grow cover crops. It is surprising, therefore, that the plan has apparently not been tried in this country, though a start has recently been made at one of our research stations. It is obvious that the growth of a leguminous crop, such as vetches or clover, which is afterwards ploughed under, is a cheap method of supplying the organic nitrogenous manure which is at once so necessary for fruit-trees and so expensive to buy in ready-made form. Moreover, if the cover crop, when necessary, is given the assistance of phosphatic and potassic fertilisers, these also are returned to the soil in organic form for the use of the trees. So easy is it to supply the necessary nitrogen in this way, that it is found to be quite possible to over-stimulate the trees if a leguminous cover crop is used too often, and a non-leguminous crop, such as rye, has to be substituted when necessary to avoid this.

The usual plan of cultivation, using a cover crop, is to plough the crop under early in spring, and to follow this by surface cultivation at frequent intervals throughout late spring and summer. This is the period when cultivation is of most value to enable the trees to withstand drought. Cultivation continues until some time in early autumn, when the next cover crop is sown. It is considered that the drying effect of the crop is beneficial to the trees in autumn, helping them to ripen their wood. Throughout the winter, of course, it serves to keep the land drier than it would be under clean cultivation, and to prevent the washing out of plant foods.

There may be something about our climate and conditions which would render the use of cover crops less advantageous than it is in other countries; but this needs to be proved by experiment on a considerable scale with different crops.

MARROW-STEM KALE FOR DAIRY COWS.

C. C. MORT.

UNTIL 1916 the writer had relied upon cabbages to provide the bulky succulent food required by cows in the autumn and early winter. About that time he had begun to seek ways of utilising land more continuously than by planting cabbages in May on fields that had been bare since the previous corn harvest, and in 1915-16 rye was grown for spring feeding prior to the planting of the "green" crop. It was on such rye stubble that the first trial was made with marrow-stem kale.*

The kale was sown on 27th May and yielded—as ascertained in November by weighing the produce of a measured plot—24 tons of green forage per acre. The green-stuff was sampled by Mr. J. R. Bond, the County Organiser, and analysed at the Midland College. The figures were as follows, the average analysis of drumhead cabbages as given in "Rations for Live Stock"† being adjoined for comparison:—

	Marrow-stem Kale. *Per cent.*	*Drumhead Cabbage.* *Per cent.*
Dry matter	12.8	11.0
Protein	1.6	1.5
Oil	.3	.4
Soluble carbohydrates	6.4	5.9
Fibre	2.8	2.0
Ash	1.7	1.2

The results of the first trial encouraged the hope that this crop might be substituted for cabbages, which had certain drawbacks—the cost of plants, the labour of planting and hoeing, and the risk of a gappy crop, owing to high mortality at planting or the ravages of the root maggot. A comparative test of the two crops was, however, made in 1917 on land just cleared of early potatoes; one half of the area was planted with cabbage, while the other was sown with marrow-stem kale. The results were decidedly in favour of the latter—it was easier and cheaper to cultivate, gave a heavier yield and appeared to be better food for the cows than cabbage. Since 1917 no cabbages have been grown on this farm.

In 1916 and 1917 the kale crop was cut with an ordinary grass-mower fitted with a reaping flake. The heaps dropped off the machine were loaded on to a cart and led out for consumption on the grass land. In the autumn of 1917, however,

* See "Enterprise in Dairy Farming," J. R. Bond, this *Journal*, August, 1916.
† The Ministry's Misc. Pubn. No. 32, price, 6d., post free.

a better method of utilising the crop was found: the gate between the kale field and the cow pasture was inadvertently left open, with the result that the cows spent the night among the kale. However, no ill effect on the cows followed, so it was decided to continue the grazing of the crop. Since that year the whole of the crop has been grazed off by the cows, and never has any ill effect on them been observed.

The usual period during which the kale crop is required for consumption on this farm is from about the middle of November until the second or third week in December. At this time the cows lie in at night and are out on the kale from about 8 a.m. until 3 p.m. The average daily ration per head in addition to kale was, in 1923, 6 lb. hay, 1 lb. straw chop, 23 lb. brewers' grains, $1\frac{2}{3}$ lb. coconut cake, and $1\frac{2}{3}$ lb. palm nut cake. Cows yielding less than 1 gallon receive no cake, others receive cake at the rate of $2\frac{1}{2}$ lb. per gallon after the first gallon. When particulars of the ration and yields were taken on 12th December last, 18 cows and 10 heifers in milk were producing 72 gallons per day.

Probably many farmers would hesitate to turn a herd of cows into a crop of this nature, naturally fearing that the cattle would take harm, that the crop would be largely wasted by being trodden down and soiled, and that the land would be badly poached. In the writer's seven years' experience of this practice none of these fears has materialised. The cows consume the crop clean and close to the ground, leaving only a stump of about $\frac{1}{2}$ in. long and, although the land in question includes heavy as well as light soils, the damage due to treading has been very small. The kale crop appears to hold the land dry.

After the kale has been consumed, the land is ploughed and as soon as practicable after the middle of January sown with wheat.

Since 1917 the writer has regularly grown marrow-stem kale after early potatoes. The lifting of the earlies usually begins about 25th June, and as soon as a convenient area, say one acre, has been cleared, it is immediately sown with kale. The land requires little preparation—only one stroke with the spring-tine harrow and another with the spiked-chain harrow. The seed is then sown broadcast at the rate of 4 lb. per acre and covered by one stroke with the chain-harrow. As the potato crop has been liberally treated with both dung and artificials, the kale requires no manure, except sometimes a top dressing of nitrate of soda after germination.

On land fairly free from charlock and other annual weeds, kale does not require drilling in rows for horse-hoeing. In 1923, however, the writer grew the crop on land where there was reason to expect weed-troubles, and he drilled the seed in rows 19 in. apart. This distance, however, proved to be unnecessarily wide. It would appear that 9 in. intervals might be ideal, as this spacing would permit of the only hoeing required, viz., that to be given immediately the drill rows are properly visible.

Marrow-stem kale is fairly resistant to finger-and-toe disease, it is capable of withstanding considerable periods of dry weather, and it is not readily injured by frost. Although early sowing is desirable, the writer sowed as late as 25th July in 1920 and obtained a very good yield. Also the date of utilisation is elastic: if the crop is not required until December it may be reserved till then, and even until the beginning of January. In the writer's experience this crop produces a great quantity of valuable green forage with the minimum of expense and labour.

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THE HOME RANGE OF WILD ANIMALS.

H. MORTIMER BATTEN, F.Z.S.

THE distances wild animals travel during the normal course of their lives have recently been much discussed in agricultural circles. Judging from various haphazard statements that have been made, it would seem there is a lack of knowledge on the subject. We may take it that almost without exception a wild animal has an individual home range, with its lair or den or seat roughly as the centre from which it works. It may, of course, have several lairs dotted up and down its main line of travel, in any one of which it rests according to the various circumstances which govern its movements; but nevertheless there is invariably some spot which it regards as home.

The routine of the backwoods trapper serves well to illustrate what is meant by home range. The trapper has his central cache containing his stores, etc., and from this central cache he runs out his trap lines along the various stream banks. At some of the more distant points he builds shelter cabins, at which he can put up should circumstances demand it, but the presence of these outlying cabins does not really affect the over-all extent of his trapping range. If, indeed, the country favours it, he arranges

all his trap lines radiating immediately from his central cache, making each line so short that he is never far enough from home for an extra outlying cabin to be necessary.

It is on exactly the same lines that most wild animals seem to plan their lives. If their food is abundant there is no need to travel far, and no need, therefore, for outlying shelters; but if, on the other hand, their food is scarce, they may have to travel great distances from one source of supply to the next, and outlying shelters are then necessary.

With few exceptions, such as the nomadic weasel tribe, animals do not travel haphazardly, and just as the trapper keeps to the streams, so do wild creatures keep to certain defined lines of their own choosing. Thus the home range represents so many crooked arms radiating from one centre like the branches of a tree. The main arm may run ten or twelve miles, and from it the minor routes branch off to the various feeding quarters of the beasts concerned. When pursued an animal generally runs roughly in a circle, which is the circle of its home range, of the country it knows, and once driven out of that area it is in strange territory, and usually at the mercy of its pursuers.

Having thus explained the chief meaning of home range, we may discuss the range of certain wild animals which are of interest on the farm.

The Hare.—As has been intimated, the distances an animal travels are decided mainly by its food. If its food is abundant its rate of travel is slow, and it probably lives month after month within a mile or two of some central landmark; but if its food is scarce, it travels faster and farther. It therefore follows that it travels greater distances in winter than in summer, and this fact has led to much misunderstanding.

Foxes, hares, and the like have been tracked across the snow for surprising distances during an extremely cold snap, and recently the statement was made that a hare—presumably any hare at any time—will travel thirty miles in a straight line during a single night. I do not doubt that a hare has been tracked that distance, but unquestionably it was a hare that had been starved out by the snow which rendered the record visible. Normally an individual hare may be seen day after day in the same two or three fields, but a starving hare during a period of snow may travel any distance. He, it should be understood, is the exception.

The accompanying sketch shows the home range of a hare I had under observation. This individual possessed a certain

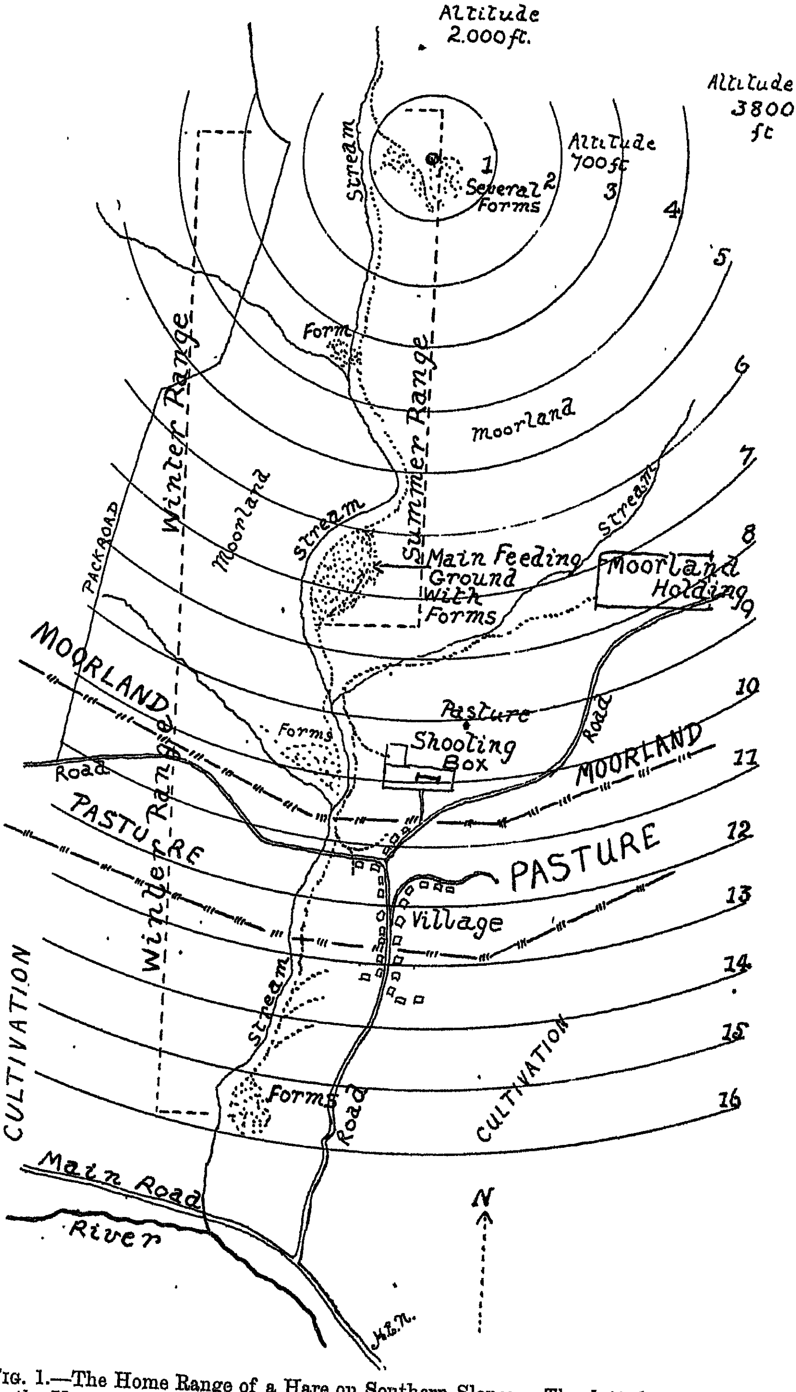

FIG. 1.—The Home Range of a Hare on Southern Slopes. The dotted lines show the Home Range and lines of Travel, and the numbers 1-16 represent miles.

feature by which it was distinguishable, and it lived in a locality where hares were rare. The chart, therefore, is as accurate as several weeks of close study of an individual animal under all weather conditions could make it, and I think it may be taken as representative of the life of the normal hare. There is considerable difference between the summer range and the winter range, and since this animal lived in mountainous surroundings it would travel farther, if anything, than the ordinary brown hare of the valleys.

In dealing with any animal—most certainly in dealing with the hare—we must not endeavour to lay down hard and fast rules. Circumstances adjust their habits. Hares mate during most of the year, only excepting a few weeks in mid-winter, and a mating hare is proverbially erratic.

I do not think, however, that hares cover more ground during their mating activities than normally, as foxes unquestionably do. Hares have certain trysting or meeting places, where they assemble in comparatively great numbers. I have myself repeatedly seen gatherings of fourteen or fifteen hares, and on one occasion counted twenty-seven together. These meeting places are usually waste land, though sometimes the hares meet on rough pasture land, and the hare population, possibly for several miles around, is apt to foregather there at night time.

The Rabbit.—The rabbit is not so great a traveller as the hare, and it is probable that 90 per cent. of the rabbits that live and die spend their lives within two or three miles of the burrow they frequent.

In a hilly country, where pasture lands are the dominant feature, rabbits frequently travel three or four miles during fine nights, returning before sunrise to the point from which they started. In order to understand how stay-at-home a creature the wild rabbit usually is, however, one need only visit a woodland border which a few of them frequent when there is a light tracking snow. It will then be seen that every yard of ground has been traversed by them, and of course this goes on the season through. If it is true of other beasts that they travel no farther than their food requirements demand, it is especially true of the rabbit, and I would say that in ordinary farm country the average rabbit spends his life within a radius of three fields.

The rabbits' home ranges, however, overlap, and while the individual rabbit does not travel far, his trail is crossed and criss-crossed by others of his kind, and their trails in turn are crossed.

The Fox.—The fox after leaving cover does not dally and linger in places where sheep and cattle feed. True, his area of travel is probably close upon twenty miles across—that is, he may travel ten miles out in either direction—but where game is plentiful he rarely leaves the coverts. Normally a fox is in strange territory eleven miles from his home centre, but I have known mountain foxes to hunt pheasants in coverts seventeen miles in a direct line from the Highland cairn where they were nursing their cubs, and to carry their kill that distance home—there being no pheasant coverts nearer. The mountain fox, however, is a child of a lean environment; he travels farther for his food than the little red foxes of the hunting Shires, and he is a hardier, huskier beast.

The fox habitually avoids the open grazing country. He prefers to stalk close under the edge of a woodland or along a ditch bottom, and whenever possible he keeps to the cover, even though it be a hedge, in preference to taking the open. His paws are small, his body is clear of the ground, his stride is comparatively long, but above all he does not loiter.

The Badger.—The badger belongs almost exclusively to the dense woodlands. A badger will make a detour of two or three fields, keeping to the hedge bottom, rathar than cross an open gate-gap. Certainly I have known cubs to play about in open pasture, and in the Tweed valley they are not popular owing to their habit of trampling down the crops; but if the badgers come into the open at all, they frequent only one small patch close to their woodland retreat. The badger is the most stay-at-home and secretive animal we have, though old dog badgers are known to live nomadic lives.

The Hedgehog.—Hedgehogs do not travel any great distance. At night time they are fond of frequenting the haunts of cattle in pursuit of the insect life generally abundant there. The hedgehog is a great lover of warmth, and will lie down close under a resting animal—a habit which has no doubt given rise to the common belief that hedgehogs suck cattle. As a rule this hedgehog is liberally infested with vermin, while his long hollow claws form an ideal germ-carrying agency. The animal is an unclean feeder, delighting in carrion, and if one is killed its paws will probably be found to be foul with unclean matter of one kind and another. I have known one to busy itself in an open pasture, turning over the dung of cattle in search of the insect life thus exposed to view.

THE FOOD AND FEEDING HABITS OF THE BLACKBIRD.

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Keeper of the Yorkshire Museum, York.

FOR many years past fruit growers throughout the country have complained of the enormous increase in the number of blackbirds and of the serious damage occasioned by them. On the other hand, many have contended that whatever damage has been done has been more than compensated for by the injurious insects which this species destroys. Unfortunately, we have not hitherto possessed that information respecting the food and feeding habits of the blackbird (*Turdus merula*, Linn.) that would enable the unbiased mind to arrive at any decision as to its economic status.

In the investigation of which the results are here given, the writer has endeavoured:—(i) to compute by the volumetric method the diet of this bird, by an examination of stomach, etc., contents from specimens obtained throughout the country and during each month of the year; (ii) to show the nature and percentage of the food taken in a fruit-growing and an urban district.

Practically every writer on the food of this species has condemned the bird as a malefactor of the worst type, the only one of any note holding a contrary opinion being Yarrell, who regarded the insects, slugs and snails eaten by it, as counterbalancing the amount of fruit destroyed. We must bear in mind, however, that in his day the blackbird was by no means so plentiful as at the present time.

Natural History.—The blackbird commences nest building in March, and eggs have been found in that month, but generally the first brood appears in April, and several broods follow up to July. The number of eggs varies from 4 to 6, 4 or 5 being the more usual. They are of a greenish blue, streaked and spotted with reddish-brown. Incubation takes about fourteen days, and the same period is occupied in fledging the nestling. The nest is built a few feet above the ground in bushes, hedge-rows, etc., rarely in trees. The case is formed of mud and horse-dung, and lined with dried grasses and moss. It is no unusual sight to see the young of this species assisting the parents to feed the later broods.

In addition to the natural increase in the resident population of this species, we have a large autumnal immigration.

Berry has directed attention to the importance of keeping in view a bird's migration habits when considering whether it should be afforded or denied protection, particularly in the breeding season. "This is a difficult question to unravel, but it is at all events clear that it is the individual bird whose services or misdeeds have to be weighed, one against the other, and not necessarily the dietaries of the different birds, or groups of birds, composing the species. If the blackbird or song-thrush that is with us during the breeding season, destroying numberless slugs and snails and noxious insects, leaves us before the autumn fruit ripens, it would be a mistaken policy to destroy that bird in the supposed interests of the apple or pear crop, however much injury may be done to these fruits by immigrant birds of the same species bred in North-western Europe."

Dr. Eagle Clarke† has shown "that a general southward migration, of the British song-thrush at all events, commences as early as the beginning of August, or even in some seasons in July, and the blackbird is seen at the lighthouses by September. Probably many remain till later in the year, and many individuals reside permanently in their native districts. . . . . . I am inclined to believe that the song-thrush or blackbird who takes a small toll of the strawberries or gooseberries in July is the individual who has been an industrious gardener all summer, but that almost before even the small-fruit season is over, many of the blackbirds and all the song-thrushes have gone from us to be seen no more for good or ill till February comes round; and that the birds seen in autumn—and for the most part in the open fields—are the migrating flocks making their way south from areas far to our north."

"If I am right in this, the indiscriminate slaughter of blackbirds and song-thrushes in the nesting season, under the belief that the fruit crops will thereby be conserved, may do more harm than good to these very crops, and this, even although fruit may form the bulk of the crop-contents of selected individuals, killed for examination in the fruit season. The fruit diet is noticed at once, but the unostentatious consumption of countless hosts of grubs and insects, especially in the early mornings, is much less readily observed."

Whilst fully admitting that this matter of migration is an important one and well worthy of closer attention by the economic ornithologist, our contention is that, in the case of the

* *Scot. Nat.*, 1917, p. 126.
† Studies in Bird Migration, Vol. 1, p. 213.

blackbird, both the non-migratory and the immigrant birds are too plentiful, hence the serious damage they have occasioned to fruit crops during recent years.

Field Observations.—Inquiries have been made personally and by correspondence in a large number of districts throughout Great Britain as to the relative abundance of blackbirds. The difficulties of such an inquiry are many, but a general concensus of opinion points to the fact that this species is far too numerous, particularly so in the midland, southern, and south-western counties.

Certain correspondents have assured us that for some years past they have annually destroyed 300 to 1,000 specimens, others have destroyed 100 to 400 eggs, and yet all are agreed that the birds are more numerous to-day than ever before.

In one or two districts we have been able to obtain comparisons with other species: thus we are variously informed that "they (blackbirds) are five or six times as numerous as thrushes"; "there are more blackbirds' nests than any other species excepting the house-sparrow and starling"; "our orchards and gardens are full of them, they are more numerous now than ever before, they will soon be as plentiful as starlings."

These and numerous other similar statements all point to the fact that in spite of the destruction that is carried out in some districts, the blackbird is far too plentiful, and that it is increasing.

Food Habits.—As the result of an examination of the stomach contents of 285 specimens we found that 39 per cent. of the total food consumed during the year is of an animal nature and 61 per cent. vegetable. The animal food may be subdivided as follows:—22 per cent. of injurious insects, 3.5 per cent. of beneficial insects, and 5.5 per cent. of neutral insects, 4 per cent. earthworms, 2.5 per cent. slugs and snails, and 1.5 per cent. miscellaneous animal matter.

Amongst the injurious insects we find wireworms, the larvæ and beetles of the clay-coloured weevil (*Otiorrhynchus picipes*, Fabr.), larvæ of various *Noctuae*, leather jackets and various dipterous larvæ.

The vegetable food consists of 25.5 per cent. cultivated fruits (strawberry, raspberry, gooseberry, currant, and apple, pear, and plum as fruit pulp), 2.5 per cent. wheat, 2.5 per cent. roots, 24.5 per cent. wild fruits and seeds, and 6 per cent. miscellaneous vegetable matter.

A summary of these different items shows that of the total food consumed the blackbird is beneficial as regards 24.5 per cent., neutral as to 41.5 per cent., and injurious as to 34 per cent.

In investigations on the food and feeding habits of the house-sparrow and the starling the writer has shown the differences that occur in the percentages of the various food items in different districts, and these have been computed for the present species also.

Food of blackbirds in Fruit-growing and Urban Districts.

Food Items.	*Five Fruit Growing Districts.*	*Five Urban Districts.*	*Average for whole of country.*
Animal food.			
Injurious Insects	16.5	23.0	22.0
Beneficial Insects	3.0	3.0	3.5
Neutral Insects	4.0	3.5	5.5
Earthworms	3.0	4.5	4.0
Slugs and Snails	3.0	3.5	2.5
Misc. animal matter ...	2.5	4.0	1.5
Household refuse	—	3.0	—
Totals	32.0	45.5	39.0
Vegetable food.			
Cultivated fruits and fruit pulp	28.5	18.5	25.5
Wheat	2.0	1.0	2.5
Roots	1.0	1.5	2.5
Wild Fruits and Seeds ...	32.0	26.0	24.5
Misc. vegetable matter ...	4.5	7.5	6.0
Totals	68.0	54.5	61.0

In fruit-growing districts, therefore, the percentage of cultivated fruits and fruit pulp is much larger than the mean average. This destruction of fruit commences as soon as it begins to ripen and continues until it is gathered. It is clear that it is much easier to obtain than any other kind of food at a certain season of the year, and during that period the percentage of animal and other food taken is at its lowest. Again, for the remainder of the year the most abundant supply of food consists of wild fruits and seeds; indeed, it may be said that it is practically only during the late winter and spring that any considerable amount of animal food is consumed.

The figures for urban districts show a decrease of 10 per cent. in the amount of cultivated fruits consumed, of 7 per cent. under the mean average, and a decrease of 6 per cent. in the

quantity of wild fruits and seeds, or 1.5 per cent. above the mean average. In such districts cultivated fruits are not so plentiful, and hence a lower percentage is consumed, or we may say that there is an abundance of food generally which is more easily obtained. This is borne out by a reference to the nature of the animal food consumed. The injurious insects show an increase of 6.5 per cent. over the fruit-growing districts, and 1 per cent. over the mean average. Taking the total bulk of insect food (injurious, beneficial and neutral) there is a decrease of 1.5 per cent. on the mean average. To summarise, we may state that in fruit-growing districts the consumption of animal food is at its lowest, being 13.5 per cent. below that of the urban districts and 7 per cent. below that of the average mean, whereas the consumption of vegetable matter in fruit-growing districts is 13.5 per cent. above that of the urban districts and 7 per cent. above that of the average mean.

Investigations conducted in this and other countries on different species of wild birds suggest that this is precisely what we should expect. Over and over again it has been pointed out that a bird feeds upon the food that is the most easily obtained, and that the reason why a species becomes injurious is that we have too many of that species feeding upon the same kind of food.

It does not seem necessary to enter into any further analysis of the figures obtained, for it is doubtless patent to every unprejudiced mind that at the present time we have too large a resident population of blackbirds—which is from time to time augmented by immigrants. The struggle for existence must be very keen, and so long as these conditions obtain in fruit-growing districts, the blackbird will continue to be one of the most destructive birds with which the fruit-grower has to contend. Before it can be regarded as a neutral or a beneficial factor its numbers will have to undergo considerable diminution.

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MAY ON THE FARM.

J. R. BOND, M.Sc.,
Agricultural Organiser for Derbyshire.

Weather Notes.—There is a natural tendency to hail May as a summer month; the days are long, there is usually a good duration of bright sunshine and there may be some hot days; buds open and flowers bloom; and both bird and insect life become manifestly active. This month, however, properly belongs

to the spring quarter; its mean temperature, normally 51° F. in the Midlands, is $5\frac{1}{2}$° F. warmer than April but $5\frac{3}{4}$° F. colder than June, and the nights are frequently chilly. Occasionally there is snow in May; on the average there are ground frosts on three to five mornings; while on the eastern side of the country cold east winds often prevail during the first half of the month. The rainfall is normally rather low and the rate of evaporation high, so that the complete destruction of "twitch" by drying is now usually possible. Up to the date of writing, however, the spring has been abnormally cold and dry, and all outdoor vegetation is backward; farmers are, therefore, looking forward with unusual interest to the advent of the fifth month.

Grass Day.—In the Midland counties cows usually begin to lie out in the pastures about the 12th of the month, "Old May Day," or in farming terminology "Grass Day." The actual date for the change from winter to summer management of cattle varies, however, according to circumstances—the class of stock, the forwardness of the grass, the weather, and the remaining supplies of fodder and roots. In this matter there is considerable difference of opinion among farmers, some contending that the pastures should be broken early, before the grass has risen to a full bite, others maintaining that too early grazing unduly exposes the sward to the effects of drought later in the season.

In favour of early grazing, it may be said that it tends to a more even consumption of the entire herbage; whereas, when there is a full bite at turning out time, the stock are apt to select the best patches, leaving the coarser herbage to run to seed. Young pastures and rotation grasses should certainly be eaten down fairly soon; and when fields are known to "eat off" badly cattle should be turned into them before they have tasted better herbage. Another argument in favour of early grazing is that it encourages the grasses to tiller and form a close sward, and it favours the clovers, which are apt to be repressed by a long growth above them.

Another series of considerations arises with regard to the class and condition of the stock to be grazed. With dry stock—strong stores and dry cows—a full bite is not necessary, and some deficiency of grass may be an advantage, in that it ensures a more gradual transition from dry winter-keep to succulent spring herbage. Such cattle are, therefore, often turned out early in April. Some thought must, however, be given to the avoidance of chills; cattle that have been managed in a manner that has

preserved their natural winter coat may lie out earlier than such as have been warmly housed and well fed all the winter.

With regard to dairy cows, especially those recently calved, it seems to be generally agreed among the best farmers that grazing should not begin until the grass affords a full bite of "mature" herbage. It is often said that the herd should not lie out until apple trees are in bloom. Cows in full milk require a liberal supply of nutriment to maintain the flow and keep up body condition; but it is difficult at this time of the year to correct deficiencies in quality or quantity of the grazing by the use of fodder or concentrates, as after tasting grass the cattle will not eat much dry food.

It is a point of good management to prepare the cows for the change from winter to summer rations and conditions. They are best protected against chills when the sheds have been kept cool and well ventilated all the winter, failing which, hardening off should begin in good time before grass-day. The change of diet is less drastic where the root supply has been so husbanded that the ration has been more succulent than usual during the latter part of April. One very good dairy farmer known to the writer endeavours to reserve a month's supply of mangolds for use after May Day. Another good practice is that of mixing green fodder—rye or rye grass specially top dressed for the purpose—with the hay and straw chaff fed during the last fortnight before turning out time.

Cow Cabbage.—On heavy soils and in dry, warm districts, dairy farmers replace the turnip crop with cabbages and mangolds. It is not practicable to sow the whole of the root break with mangolds—some portions may require more spring working than is conducive to good results with that crop; and in any case mangold roots do not reach a satisfactory stage of ripeness for feeding until about the end of the year. From the time when grass ceases to grow—about the end of October according to the season and district—and until about the New Year, cow cabbages may provide suitable green food.

Under favourable circumstances—moist land in rich condition and a moderately warm and sunny season—yields of 50 or more tons of heads per acre are obtainable without irrigation, while crops weighing 25 to 30 tons per acre are typically fair results of ordinary good farming. For high yields, however, it is important to secure plants of a good strain; in one of the writer's experiments the difference in yield due to strain amounted to 15 tons per acre, while that due to fertilisers was 10 tons.

The best plants are produced by small market gardeners who obtain their stock-seed by personal selection. In autumn they go through fields planted with seedlings of their strain and select a dray load of the largest, firmest and best shaped heads; which they afterwards set out for seed production. This practice, pursued for many years, has resulted in the development of local strains of high productivity. One important respect in which they excel ordinary drumheads is their ability to keep firm in the heart until Christmas time, whereas the latter often heart and burst too soon for dairying conditions. The plant grower sows the cabbage seed in August, and about October transplants the seedlings into rows or beds, from which they are drawn for sale in May.

Cow cabbages resemble mangolds in their soil and manurial requirements—firm rooting ground, moisture, and liberal supplies of nitrogen. Flat cultivation has the advantage of permitting the horse hoe to be used in two directions, the land being first "scrawled" out lengthways and crossways (or diagonally) and the plants being set in the points where the marks intersect. On heavy land, however, it is usually better to grow the crop on ridges, owing to the fact that the crop has to be harvested in November and December.

At planting time the soil should be firm and moist; loose, cloddy ridges do not afford proper rooting conditions. Where the tilth is rather harsh and dry—and strong land usually is in that stage after spring cleaning operations—the ridges should be ridge-rolled and allowed to lie a week or two before planting. The soil should be firm enough to require the use of a spade rather than a dibble for planting. An ordinary spacing for the plants on good land is 30 in. each way, for which 7,000 plants are required for one acre; when spaced 24 in. apart in 27 in. drills, as on less productive soils, about 10,000 plants are required per acre.

In cool seasons late cow cabbages may fail to heart satisfactorily, as was not uncommon in 1923; in dry sunny years, however, a more serious trouble may be encountered—the root maggot. From actual experimental trial the writer can vouch for the effectiveness of "discs" put round the stem of the plants at planting time;* but this method is hardly so convenient to adopt as that of sowing pungent substances—such as powders containing creosote or naphthalene or even soot—round the plants.

* See the Ministry's Leaflet No. 122.

MANURES FOR MAY.

H. V. GARNER, B.A.,
Rothamsted Experimental Station.

Manures for Swedes.—The manurial treatment for this crop depends on two main factors, the lime supply of the soil, and the climatic conditions. If the soil is sour trouble will almost certainly arise through the disease known as finger-and-toe, and treatment must be directed towards correcting acidity as much as towards feeding the crop. The soundest remedy for finger-and-toe is to lime or chalk the land, but if this cannot be undertaken a partial but less satisfactory remedy is to substitute nitrate of soda or nitrate of lime for sulphate of ammonia, and basic slag for superphosphate. It is doubtful if the latter course is of much value if the soil is distinctly acid, but it does postpone the setting up of sour conditions, and this is of importance in the case of fields containing a very small amount of lime.

The climatic conditions largely determine how big a crop of swedes can be grown. In most areas a yield of 25-30 tons per acre is not unusual, while in the drier and hotter districts of the south only about half that yield is obtained. The scale of manuring should therefore be adapted to the size of the average crop. The most important constituent in the manure for swedes is phosphate, and superphosphate is the form which is most commonly chosen, on account of its quick-acting properties. A supply of phosphate helps the young plant to make a good start and brings it early to the hoe; it also improves the feeding value of the roots. Swedes can be grown without dung on cool soils and in moist areas, but in droughty districts short dung is of great value for its water-holding properties. If no dung is used and fair crops are possible, potash should be included in the mixture in all but the stiff soils, and care must be taken not to limit the crop by lack of nitrogen.

The following dressings per acre, modified as suggested above for soils short in lime, have been found suitable under the conditions stated:—

(*a*)	(*b*)	(*c*)	(*d*)
Thin sheep downs.	*Dry districts.*	*Moist areas, with dung.*	*No dung available.*
3 cwt. superphosphate.	10 tons dung, 3 cwt. superphosphate.	10 tons dung, 4 cwt. superphosphate, 1 cwt. sulphate of ammonia.	5 cwt. superphosphate, 1 cwt. sulphate of ammonia, 1 cwt. muriate of potash.

All these manures should be applied before sowing. In the case of (*d*) 1 cwt. of nitrate of soda may be given as a top dressing after singling if thought necessary.

Potash for Grassland.—The inclusion of potash in the manures for hay land is now fairly general on all but the stiffer soils, and experience often shows that even heavy land cannot stand the drain of potash which continuous mowing involves.

The value of potash manures for the improvement of grazing land, particularly on the lighter soils, is also becoming recognised. The first year's results of a manuring-for-milk experiment commenced in 1923 at the Staffordshire Farm Institute have recently been published. A poor light-land meadow which only yielded about 12 cwt. of hay per acre was devoted to the experiment. It was limed at the rate of 2 tons per acre and fenced off into three plots each of 3½ acres, which were grazed by dairy cows for 18 weeks, the milk being weighed. The figures for 1923, which are preliminary in nature, are given below:—

Treatment per acre.	*Milk, gal. per acre.*
No manure.	264
4 cwt. superphosphate.	261
Do. + 1 cwt. sulphate of potash.	322

At present prices the increase obtained by the use of the mixture of phosphate and potash is amply remunerative. The results were in agreement with observations made in the field, where it was noted that phosphate alone had little effect, but the combination of phosphate and potash gave a vigorous leguminous herbage. Although sulphate of potash was used in this particular case similar results could be looked for from the application of the same amount of potash in the form of muriate of potash, or the lower grade of potash manures.

Storage of Dung.—It sometimes happens that dung made in spring cannot be carted out and applied for the current season's crops. In such cases it must be stored till the autumn. Summer storage involves bigger losses of nitrogen and dry matter by fermentation than occur in winter, and although these losses cannot be prevented they can in some degree be controlled by good management. If the dung has been made in covered yards or boxes its manurial value is best preserved by leaving it undisturbed, but if it lies in open yards or exposed heaps it should be made into as tight a clamp as possible and a covering of earth provided. A disadvantage of summer storage, particularly if the heap is kept under cover, is that the manure may become too dry. This retards the rotting of the straw, and the nitrates which are produced under dry conditions are liable to decompose if the heap is subsequently wetted.

Experiment has shown that less loss of fertilising constituents occurs under cover than in the open, and to keep the manure moist it is preferable to conserve as much as possible of the liquid originally present by keeping the dung compact, rather than to pump water or liquid manure over the heap.

Cabbages.—Autumn-planted cabbages intended for summer use may have their final dressing of about 1 cwt. per acre of nitrate of soda or sulphate of ammonia at this time of the year if they appear to require a little help. Cabbages drilled or planted in spring will respond to a complete artificial fertiliser in addition to dung, and if farmyard manure is not available a generous supply of artificials will be needed to grow good crops. Nitrogen is the main requirement on most classes of land, but nitrogenous manuring unbalanced by phosphate and potash tends to give an open habit of growth very undesirable in cabbages. On stiff land the need of phosphates is greater than of potash; on lighter soils both are necessary. Suitable dressings per acre for medium land would be:—

(a) *With dung.*		(b) *Without dung.*	
4 cwt. superphosphate.	Before drilling or planting.	6 cwt. superphosphate.	Before drilling or planting.
½ " muriate of potash.		1–2 cwt. sulphate of ammonia.	
2 " nitrate of soda.		1 cwt. muriate of potash.	
		2 cwt. nitrate of soda.	

The nitrate of soda would be given in two top dressings during the growing season and in the case of widely spaced varieties it is preferable to apply it by hand near the stems of the plant rather than broadcast over the whole area. Salts such as kainit, sylvinite or potash salts are quite as suitable for cabbages as muriate of potash, for the common salt introduced with such substances benefits the crop. Similar manurial treatment may be given to Brussels sprouts and broccoli, and in intensive culture the above dressings of nitrate of soda are often considerably increased. No nitrate of soda would be applied late in the season to crops which have to stand the winter, it being more profitably reserved till growth commences in the spring.

Manurial Residues.—The bulk of the fertilisers for the season's crops will now have been applied, and it is of interest to consider what residues can be expected from these dressings for the use of future crops. There are two main sources of information on this point: (1) the evidence derived from the chemical behaviour of manures in the soil, and in particular from the analysis of drainage water from soils manured in different ways; and (2) the results of field experiments where the residues are measured by the crops which they produce.

Nitrogenous Manures.—The soil has no power to retain nitrates; hence nitrogen supplied in the form of nitrates of soda or of lime leaves no direct residue. The same applies to the nitrogen of sulphate of ammonia, dried blood and rape cake, which is speedily converted into nitrate in the soil. If the bigger crops of roots and straw grown by the use of such manures are fed on the farm the dung heap receives indirect benefit in this way, but only a small part of the nitrogen in the manure is thus restored to the soil. If, for example, by the use of 1 cwt. per acre of sulphate of ammonia the oat crop is increased by 7 bushels per acre and a proportionate amount of straw, the quantity of nitrogen recovered in the increased produce would be about 9 lb. If both corn and straw are fed we can expect that about half of this nitrogen will find its way back to the land through the dung, hence of the 23 lb. of nitrogen provided by 1 cwt. of sulphate of ammonia, 4½ lb. or 20 per cent. returns to the land. The above case, however, is a favourable one because all the produce is fed on the holding; if the grain was sold the restoration of nitrogen would fall to about 6 per cent.

A large proportion of the nitrogen of fish meal, meat meal, and guano is quickly nitrified and therefore yields no direct residue; any more resistant balance will come in for the following crop. The nitrogen of shoddy is slower in its action, and its effects, although greatest in the first year, have been traced through three successive crops at Rothamsted.

Phosphates and Potash.—Investigations on the behaviour of these substances when applied to the soil show that phosphates, even if applied in a water-soluble condition, are almost wholly retained in the surface soil, and that even after many years a large proportion of this retained phosphate exists in a citric-soluble form. Potash manures, although largely retained, travel faster into the subsoil and bulk rather more largely in the drainage than do the phosphates. The most serious drain on both phosphates and potash is that caused by the growing crop. The approximate amounts of these constituents removed from the soil by the crops of a five-course rotation are given below. Quantities of phosphoric acid and potash may be converted into their equivalents of 30 per cent. superphosphate or 50 per cent. muriate of potash by multiplying by the factors 7.2 or 2.0 respectively.

Year.	Crop.	Yield per acre.	Removed in Crop. Phos. acre.	Pot.	Disposal of Crop.
			lb.	lb.	
1st	Mangolds 1/3 ac. (1 acre)	22 tons roots	12.1	74.3	roots fed.
	Potatoes „	6 „ tubers	7.2	25.5	sold.
	Swedes „	11 „ roots	5.6	21.1	roots fed.
2nd	Barley, 1 ac. grain	40 bus.	16.0	9.8	sold.
	„ „ straw	24 cwt.	1.7	25.9	to dung.
3rd	Clover, 1 acre	2 tons	21.9	83.4	fed.
4th	Wheat, 1 ac. grain	30 bus.	11.2	9.3	sold.
	„ „ straw	25 cwt.	6.9	19.5	to dung.
5th	Oats, 1 ac. grain	45 bus.	13.0	9.1	fed.
	„ „ straw	25 cwt.	6.1	37.0	fed.

The loss of phosphate and potash from 1 acre during a complete rotation will be the amounts of these constituents contained in the crops sold off together with about one-quarter of that contained in the crops fed, this being the usual estimate of the loss of phosphate and potash which occurs in making dung. The loss of phosphate by drainage is negligible, but there will usually be a very small loss of potash in this way. From the above figures we obtain :—

Loss of phosphate and potash (lb. per acre) during a 5-course rotation

		Phosphoric acid.	Potash.
Removed by crops sold off	...	37.4	44.6
Lost in making dung	...	15.5	56.2
Total loss during 5 years	...	52.9	100.8

Hence under the above system the loss to 1 acre of soil due to cropping will be 53 lb. of phosphoric acid and 100 lb. of potash, equivalent to about 2½ cwt. of 30 per cent. superphosphate and 2 cwt. of muriate of potash per rotation. Under ordinary conditions the quantity of superphosphate will often exceed 2½ cwt. per rotation, for 4 cwt. might well be given to roots and a further 2 cwt. to the second corn crop. The quantity of potash will rarely exceed the 2 cwt. per acre per rotation required to maintain the soil; 1 cwt. would probably go to the roots and a further ½ cwt. might be given to the clover or oats on light soil, but it is seldom that more potash than this would be used. Any purchased foods consumed on the holding would enrich the dung to the extent of their manurial value and improve the phosphate and potash balance to that extent.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average Price per ton during week ending April 2nd.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	14. 0	13.12	13.17	17.11
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	14. 2*	14. 2*	14. 2*	14 2.*	(N)13. 7
„ „ „ neutral (A. 25¾ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5
Kainit (Pot. 12½ per cent.)	...	...	...	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
„ „ (Pot. 20 per cent.)	...	...	...	2.17	2.10
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	...	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7. 7	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 28 per cent.)	...	2. 4§	...	...	...
„ „ (T.P. 26 per cent.)	2.13§	2. 0§	...	...	...
„ „ (T.P. 24 per cent.)	2. 9§	1.16§	2. 0§	..	...
„ „ (T.P. 18 per cent.)	2. 3§	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.15	2. 2
„ (S.P. 30 per cent.) ...	3.16	3. 7	3. 8§	3. 7	2. 3
Bone Meal (A. 4½. T.P. 45 per cent.) ...	9.10	8.15	8.17	8. 5	...
Steamed Bone Flour (A. 1. T.P. 60 per cent.)	6.10	6.17†	6. 5	6.12†	—
Fish Guano (A. 9-10. T.P. 16-20 per cent.)...	12.15	...	12.10	...	...
„ „ (A. 11, T.P. 10 per cent.) ...	...	...	...	13.10	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Evaluation of Feeding Stuffs and its Relation to Recent Research.—Comparatively recent developments in research in animal nutrition have emphasised the importance of including in rations for farm animals adequate quantities of mineral salts, and other substances of unknown chemical composition labelled for convenience "vitamins."

Mineral Substances in Rations.—It has been clearly established that the inclusion of certain mineral substances is essential to the growth and well-being of an animal. Normally such substances are contained in adequate amounts in the ration fed to the animal. Owing, however, to the fact that certain foods are deficient in one or more of these mineral elements, a ration is occasionally met with which is deficient in these elements. In such a case, the actual addition of mineral substances to the ration has been shown to be followed by beneficial results and to be economically a sound policy. In the case of animals yielding milk in large quantity, such as a 2,000 gallon cow, it may also be necessary to add mineral substances to the ration to allow for the drain on the organism caused by the heavy yield of milk. The elements that experience has found to be normally deficient in certain dietaries are Calcium, Phosphorus, Chlorine and Sodium. Recent research has also indicated that under certain conditions Iron may be deficient to such an extent that severe metabolic disturbances may arise.

Cheap and convenient sources of supply of the above elements are to be found in chalk, common salt, steamed bone flour, and precipitated phosphate. It must be remembered that excess of Phosphorus is normally excreted from the body in the form of calcium phosphate, and it is therefore desirable to supply any calcium deficiency in a dietary in the form of chalk rather than bone phosphate.

Vitamins.—The story of vitamins has been given sufficient publicity elsewhere to render its repetition unnecessary here. Briefly stated, it has been found that certain substances called "vitamins" are essential to growth and healthy development, and their absence in dietaries causes malnutrition and severe

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	—	—	10/11	10 18	0 16	10 2	71·6	2/10	1·52
Barley, British Feeding	—	—	10/9	10 15	0 12	10 3	71	2/10	1·52
,, Canadian No. 4 Western	34/6	400	9/8	9 13	0 12	9 1	71	2/7	1·47
,, Tunisian	33/6	—	9/5	9 8	0 12	8 16	71	2/6	1·34
,, Karachi	33/3	—	9/4	9 7	0 12	8 15	71	2/6	1·34
Oats, English, White	—	—	10/4	10 7	0 14	9 13	59·5	3/3	1·71
,, ,, Black and Grey	—	—	9/8	9 13	0 14	8 19	59·5	3/–	1·61
,, Canadian No. 2 Western	26/9	320	9/4	9 7	0 14	8 13	59·5	2/11	1·56
,, ,, No. 3 ,,	25/9	,,	9/0	9 0	0 14	8 6	59·5	2/9	1·47
,, Canadian Feed	24/6	,,	8/7	8 12	0 14	7 18	59·5	2/8	1·47
,, Argentine	22/6	,,	7/10	7 17	0 14	7 3	59·5	2/5	1·29
,, Chilian	24/6	—	8/7	8 12†	0 14	7 18	59·5	2/8	1·43
Maize, American	42/6	480	9/11	9 18†	0 13	9 5	81	2/3	1·20
,, Argentine	43/9	—	10/2	10 3	0 13	9 10	81	2/4	1·25
Beans, Rangoon	—	—	11/4	11 7†	1 13	9 14	67	2/11	1·56
Peas, Japanese	—	—	22/3	22 5†	1 9	20 16	69	6/–	3·21
Millers' Offals:—									
Bran, British	—	—	—	7 7	1 7	6 0	45	2/8	1·43
,, Broad	—	—	—	8 5	1 7	6 18	45	3/1	1·65
Middlings Fine (Imported)	—	—	—	7 9	1 3	8 4	72	2/3	1·20
,, Coarse (British)	—	—	—	7 17	1 3	6 14	64	2/1	1·12
Pollards, Imported	—	—	—	7 5	1 7	5 18	60	2/–	1·07
Meal, Barley	—	—	—	10 10	0 12	9 18	71	2/9	1·47
,, Maize	—	—	—	11 15	0 13	11 2	81	2/9	1·47
,, ,, Germ	—	—	—	9 12	0 19	8 13	85·3	2/–	1·07
,, ,, Gluten-feed	—	—	—	9 7	1 8	7 19	75·6	2/1	1·12
,, Locust Bean	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
,, Bean	—	—	—	13 0	1 13	11 7	67	3/5	1·83
,, Fish	—	—	—	20 0	4 8	15 12	53	5/11	3·17
Linseed	—	—	—	20 5	1 12	18 13	119	3/2	1·70
,, Cake, English 12% Oil	—	—	—	13 0	1 19	11 1	74	3/–	1·61
,, ,, 10% Oil	—	—	—	12 0	1 19	10 1	74	2/9	1·47
,, ,, 9% Oil	—	—	—	11 17	1 19	9 18	74	2/8	1·43
Cottonseed Cake, English 5½% Oil	—	—	—	7 15	1 16	5 19	42	2/10	1·52
,, ,, Egyptian 5½% Oil	—	—	—	7 12	1 16	5 16	42	2/9	1·47
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 5†	2 16	10 9	71	2/11	1·56
Coconut Cake 6% Oil	—	—	—	9 15	1 11	8 4	73	2/3	1·20
Palm Kernel Cake 6% Oil	—	—	—	7 15†	1 5	6 10	71·3	1/10	0·98
Feeding Treacle	—	—	—	6 15	0 8	6 7	51	2/6	1·34
Brewers' Grains:—									
Dried Ale	—	—	—	8 0	1 5	6 15	49	2/9	1·47
,, Porter	—	—	—	7 10	1 5	6 5	49	2/7	1·38
Wet Ale	—	—	—	1 15	0 9	1 6	15	1/9	0·94
,, Porter	—	—	—	1 10	0 9	1 1	15	1/5	0·76
Malt Culms	—	—	—	8 0	1 15	6 5	43	2/11	1·56

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

metabolic disturbance. Other facts have also been demonstrated: (1) that it is difficult to obtain foods absolutely free from vitamins, and (2) that animals vary in their reaction to the absence or presence of these vitamins. Moreover, it has been shown that under ordinary farming conditions, the usual mixed ration given to animals contains the necessary vitamins in adequate amounts, and there is generally no need to make special provision for the supply of vitamins.

How do the above facts affect our methods of evaluating feeding stuffs? From the purchasing standpoint the value of a feeding stuff depends upon its nutritive value and its manurial value. The nutritive value has hitherto been based upon its starch equivalent or fattening capacity. Should the mineral constituents or the vitamin content be taken into consideration in assessing the nutritive value? The answer is, No, under ordinary circumstances, (1) for the simple reason that the value of the mineral or the vitamin in a feeding stuff depends entirely upon the nature of the ration with which it is fed, and (2) because there is reason to assume that after the basal requirement of the organism for vitamin or mineral is satisfied any further mineral or vitamin added is of little or no value.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·20	2 3	71·6	8 1	0 16	8 17
Oats	1·20	2 3	59·5	6 14	0 14	7 8
Barley	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes	1·20	2 3	18·0	2 1	0 4	2 5
Swedes	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds	1·20	2 3	6·0	0 14	0 3	0 17
Good Meadow Hay	1·47	2 9	31·0	4 5	0 14	4 19
Good Oat Straw	1·47	2 9	17·0	2 7	0 7	2 14
Good Clover Hay	1·47	2 9	32·0	4 8	1 1	5 9
Vetch and Oat Silage	1·34	2 6	14·0	1 15	0 7	2 2

* * * * * *

Export of Horses Traffic.

IN the House of Commons on 26th February last Lady TERRINGTON asked the Minister of Agriculture whether he is aware of the traffic in worn-out horses; how many have been exported from this country during the last six months; and what steps he is taking to prevent this traffic?

The Rt. Hon. NOEL BUXTON, Minister of Agriculture, replied: "I should explain that there is no traffic in

worn-out horses because the Ministry insists on a very high standard of fitness in all horses for export, and no horse is passed for shipment unless it is in every sense fit to travel and to work. I intend to do everything in my power to maintain in full vigour the stringent regulations which have been in force during the past three years, and have effectively removed any undesirable features from this trade 10,918 horses were shipped from Great Britain to the Continent during the six months from August, 1923, to January, 1924. A considerable number of the animals are of high value, but owing to the high price of other meat on the Continent, horse fleshers are able to pay high prices for quite good class horses to be slaughtered for human food. I have no power to prevent butchers purchasing such horses after their arrival on the Continent, but, so far as I can ascertain, many of these horses are slaughtered in public abattoirs by humane methods. The last part of the question does not therefore arise."

* * * * * *

Testing Varieties of Farm Crops.

THE Ministry attaches great importance to the question of the testing of varieties of farm crops—work which, if skilfully and systematically carried out, will afford information as to the qualities of any particular crop and its suitability for different soils or climatic conditions.

In the past British farmers have had, apart from actual trial, no certain means of recognising real improvements (particularly for their own farms) among the crowd of fresh introductions; and it has become essential, if waste and disappointment are to be avoided, that every new introduction should be vouched for by trustworthy tests extending over several years in a variety of soils and climates. The benefits which may be expected from well-planned trials are indicated by the results obtained in Denmark and by the remarkable improvements in the yields and quality of Irish barley during the last twenty years consequent upon a comprehensive system of trials begun in 1901.

Such work was among the objects for which the National Institute of Agricultural Botany was established. Carried out hitherto on a limited scale, the work of this Institute is now to be considerably extended through the action of the Ministry, which is making arrangements for some half-dozen stations to be established in typical arable areas which will all work to a common scheme formulated by the Institute.

The Development of Research in Agricultural Engineering.

HITHERTO the Ministry has accorded somewhat different treatment to research in agricultural engineering from that given to research in all other subjects of an agricultural nature. It will be recalled that in its administration of agricultural research in general, the Ministry has arranged for research in separate subjects related to agriculture, *e.g.*, horticulture, plant breeding, etc., to be dealt with at one or more Research Institutes specially established for the purpose, which are either departments of Universities or independently governed bodies. Thus research in horticulture is dealt with at the Long Ashton Station which is administered by Bristol University, at the East Malling Station which is administered by a separately incorporated governing body, and at the Horticultural Research Station at Cambridge which is administered by Cambridge University. Rothamsted Experimental Station, which undertakes research into the two subjects of plant nutrition and plant disease, is an example of an independently governed station.

The Ministry has, however, for some years now been directly responsible for investigations in agricultural machinery. There were at the inception of research into this subject special reasons for singling out agricultural engineering for different treatment from that obtaining in other branches of agricultural science. The subject was quite new to this country. There was no University or other Institution which had devoted attention to the subject, while on the other hand, the Ministry had accumulated a great deal of knowledge and experience in it during the war and had in its service a number of officers familiar with the practical side of agricultural machinery. There were, however, obvious objections to this arrangement being made permanent and to the treatment of machinery research being kept separate from that of research in all other agricultural subjects.

In deciding to set up a separate research institute in agricultural engineering, the Ministry came to the conclusion that it would be preferable to attach such an institute to a University, rather than to establish a separate institute, and Oxford University was chosen for the purpose. That University has now accepted the proposal and an Agricultural Engineering Institute will accordingly function there from 1st April, 1924.

The University has chosen as the Director of this new Institute, Captain B. J. Owen, M.Sc., M.Eng. The effect of this choice will be that complete continuity of work on research problems in agricultural engineering will be secured, notwithstanding the transfer of such research from the Ministry to Oxford, since Captain Owen has, for some time, taken an important part in connection with the Ministry's machinery research.

While the responsibility for research and investigation will be transferred to Oxford University, the Ministry proposes itself to inaugurate a scheme for the testing of agricultural machinery. It proposes that tests should be carried out and certificates issued on its authority, but that the actual work of testing shall be conducted by the new Oxford Institute, the National Physical Laboratory, and other Institutions. It is expected that the testing scheme can be made self-supporting and that fees will be charged on this basis.

* * * * * *

Spraying of Fruit Trees with Arsenate of Lead: Danger to Bees.

THE Ministry again desires to bring to the notice of fruit growers throughout the country the danger to bees which may be caused by the spraying of fruit trees *when in open blossom* with washes containing arsenate of lead. It is not desired to discourage the use of arsenate of lead sprays, as these are of the greatest value in controlling the Winter and "Tortrix" moths, the larvæ of which are responsible for an enormous amount of damage to fruit trees. Spraying with this substance, however, should be restricted, as far as possible, to two definite periods, viz., before the blossom buds open and immediately the petals have fallen. In the case of apples, an application during the earlier period will give better results than at any subsequent time—especially against "Tortrix" moths. Spraying during the actual blossoming period is particularly to be deprecated on account of the fact that heavy mortality may be caused to bees visiting blossoms on which the spray has fallen. It is realised that, as the different varieties of fruit trees do not come into blossom at the same time, it may be a matter of some difficulty to arrange that no open blossoms whatever are sprayed, but instances have been brought to the notice of the Ministry of the indiscriminate spraying of open blossoms with lead arsenate, for which no reasonable excuse can be put forward.

Bees are of great value to the fruit grower by the assistance

own interests, therefore, as well as for the sake of the bee-keeper, the fruit grower should spare no effort to avoid any unnecessary mortality among these beneficial creatures.

* * * * * *

Experiments in Table Poultry Breeding.

THE Ministry has received the concurrence of the Treasury in its proposals to carry out practical experiments at the South Eastern Agricultural College, Wye, Kent, in the breeding of poultry for table use. The objects of the experiments will also cover the disposal of the surplus stock of birds on commercial egg farms. In the first place experiments will be undertaken:

(1) To ascertain the weight and value of weight gained by various breeds and cross breeds of poultry in relation to the weight and value of food consumed; also the feeding costs of finishing fowls for the table and the best breeds or cross breeds to use for this purpose.

(2) To ascertain the most profitable methods of feeding and marketing birds produced as a by-product on commercial egg farms.

(3) To ascertain the value for table purposes of the breeds most generally used by commercial egg farmers, as compared with the breeds and cross breeds usually regarded as best for table use; also, whether it is likely to be profitable for commercial egg farmers to continue producing chickens for table use, from the birds they usually keep, at times of year other than the usual season for hatching laying fowls, and if so, what are the best methods of feeding and marketing the birds.

The experiments will be begun with a small number of breeding pens composed of the following breeds and cross breeds:— White Leghorn, White Wyandotte, Rhode Island Red, Light Sussex, Indian Game crossed with Light Sussex, and Silver Grey Dorking crossed with Light Sussex. All suitable eggs laid by these birds will, if practicable, be incubated during the whole of the first year of the experiments. The chickens from each breed and cross breed will be divided into four lots and marketed as:—(*a*) "petits poussins"; (*b*) chickens off the run; (*c*) trough-fed chickens; and (*d*) chickens fed by cramming.

The Governors of Wye College have generously provided a site for the experiments on the College farm, and have provided other facilities in connection with them. The investigations are to be carried out as part of the National Poultry Institute Scheme, and the programme has been formulated and the site

for the experiments selected by a Sub-Committee of the Ministry's Poultry Institute Advisory Committee. That Sub-Committee will also be responsible for the conduct of the experiments, and for the issue from time to time of reports on the progress of the work. Four of the six existing members of the Sub-Committee are nominees of the National Poultry Council. The Chairman is Principal R. M. Wilson, M.A., B.Sc., of Wye College, and the other members are Mr. Harold Corrie, Mr. J. H. Dowden, Mr. A. P. F. Grant, Mr. Nelson Kenward (nominated by the Ministry), The Revd. H. Mayall, Mr. A. S. Juniper (co-opted by the Sub-Committee), and one member remains to be appointed.

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Farmers' Visits to Rothamsted Experimental Station.

THE Director of Rothamsted Experimental Station extends a cordial invitation to Farmers' Associations and Clubs, Chambers of Agriculture and Horticulture, Students' Societies and other bodies interested in agriculture or market gardening to inspect the Experimental Plots during the coming summer. Mr. H. V. Garner, B.A. (Camb.), will be available to demonstrate the Plots at any time, and all who come can be certain that under his guidance their visit will prove both useful and interesting.

Among important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds and potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstrations of good types of tillage implements, tractors, etc. At any convenient time between now and 30th October there is sufficient to occupy a full day, and there is provision for ensuring that the time shall not be lost, even if the weather turns out too bad to allow of close investigation of the fields.

The Director of the Station, Sir John Russell, will be happy to arrange full details with organisations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. If possible, arrangements should be made beforehand; but it is recognised that farmers' movements must often depend on the weather, and no farmer need stay away because he has been unable to write fixing a date.

All communications and requests to visit the Station should be addressed to the Secretary, Rothamsted Experimental

ample notice could be given so as to avoid the possibility of dates clashing.

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Foot-and-Mouth Disease.—Since the last issue of the *Journal*, the position in regard to this disease has materially improved, the number of outbreaks during the weeks ended 30th March, and 6th, 13th, 20th and 27th April being respectively 36, 28, 14, 16 and 9.

During that period, the following new centres of disease were brought to light, namely, Enfield (Middlesex) on 6th April, which involved an extension of the infected area; Pluckley, Ashford (Kent), on 11th April, involving an extension of the existing area in Kent; Saxham, Bury St. Edmunds (Suffolk), on 13th April, also involving an extension of the existing area; Great Smeaton, Yorks (N.R.) on 20th April, the circumstances of which necessitated a large area in the North and West Ridings, as well as a part of Durham, being declared infected, as Northallerton and Halifax markets were involved; at Glasgow on 22nd April, necessitating an infected area being declared, including parts of Lanark, Dumbarton, Stirling, Renfrew and Ayr; and at Northolt, Middlesex, on 23rd April, infected area restrictions being imposed over a 15 mile area in consequence.

Recurrences of disease have also taken place in the Hendon district of Middlesex and the Gamrie district of Banffs, the latter on the 16th April, necessitating the reimposition of restrictions over the usual 15 mile area in Aberdeen and Banff.

The limits of several infected areas have been reduced in consequence of the much improved position.

The position from the 27th August, 1923, to the 27th April is as follows:—

Number of outbreaks	... ...	3,064
Counties affected:—In	England ...	39
,,	Wales ...	2
,,	Scotland ...	11
Animals authorised to be slaughtered ...	Cattle ...	102,917
	Sheep ...	42,904
	Pigs ...	47,656
	Goats ...	125

Foot-and-Mouth Disease: Standstill Order not to be issued:—During the past fortnight the Minister has had under consideration representations made to him in favour of the imposition for a period of three weeks of a "Standstill" Order for all cattle, sheep, pigs and goats with the object of hastening the eradication of foot-and-mouth disease.

To be effective for the purpose in view the Ministry considers that it would be necessary—

(*a*) to maintain an Order of this kind in operation for at least 28 days;

(*b*) to apply it to the whole of the infected areas, which include nearly all the Midland and Northern counties of England as well as certain Southern and Eastern counties and also parts of Scotland; and

(*c*) to apply the Order not only to store animals but also to those intended for slaughter, inasmuch as the experience of recent months has shown that the movement of fat stock is attended by as great a danger of the spread of infection as that of store stock.

This would mean that fat stock would not be allowed to be removed alive for slaughter but would have to be killed and dressed on the farm, and that the urban centres would have to set up some organisation to ensure an adequate meat supply for their populations.

The prohibition of the movement of store stock also, even with modifications to admit of purely local movements by licence for the essential purposes of milking, feeding, and for emergencies, would especially at this time of the year be attended by grave inconvenience to farmers engaged in restocking their farms and in arranging for the return of sheep from their winter quarters. To this must be added the heavy losses which would result to the distributive branches of the livestock industry, and therefore to the consumer, from the application of the Order.

The Minister has carefully reviewed all the circumstances for and against the adoption of this expedient, and has come to the conclusion that he would not be justified in imposing upon the public an Order of so onerous a character as that proposed. Moreover, the Ministry thinks that the enforcement of such an Order would be found to be impracticable, and that even if an attempt to enforce it were made, it would not be possible to guarantee the desired results. The Minister has therefore definitely decided against the issue of a Standstill Order.

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International Dairy Exhibition in Argentina.—In a note in this *Journal* for January, 1924, p. 974, it was announced that an International Dairy and Refrigerating Machinery Exhibition would be held at Buenos Aires in May, 1924. The exhibition has been postponed to 1st September, 1924.

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Leaflets issued by the Ministry.—Since the date of the list given on pages 770-771 of the November issue of the *Journal*

The following new leaflets have been issued:—

- No. 7.—The Wheat Bulb Fly.
- ,, 310.—Seed Mixtures for Grassland and Some Directions for Laying Down to Grass.
- ,, 311.—Agricultural Credit Societies.
- ,, 314.—The Bacon Pig.
- ,, 316.—Lavender: Its Cultivation for Marketing and Distilling.
- ,, 318.—Currants.
- ,, 323.—The Cultivation and Marketing of Cabbage and Savoys.
- ,, 359.—Brussels Sprouts.
- ,, 391.—Barley Growing.

The following Leaflets have been re-written:—

- No. 80.—The Use of Artificial Manures.
- ,, 132.—Slugs and Snails.
- ,, 150.—Pea and Bean Beetles.
- ,, 259.—Swift Moths.
- ,, 283.—The Storage of Apples and Pears, Commercial Storage.
- ,, 320.—The Manuring of Vegetable Crops.

The following Leaflets have been revised:—

No. 5.—Mangold Fly.
,, 114.—The Scientific Principles of Feeding Poultry.
,, 146.—The Value of Records of the Milk Yields of Cows.
,, 187.—The Selection and Milking of Dairy Cattle.
,, 254.—The Use of Seaweed as Manure.
,, 297.—Seed Testing. The Seeds Act, 1920, and Seeds Regulations, 1922.
,, 329.—Redemption of Tithe Rentcharge and Corn Rents: The Tithe Act, 1918.
,, 400.—List of Publications.

The following leaflets have been amended:—

No. 244.—The Destruction of Rats.
,, 395.—Diseases of Adult Bees. (Addendum on Acarine Disease.)

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NOTICES OF BOOKS.

The Possibilities of British Agriculture.—(Sir Henry Rew and Sir E. J. Russell. London: John Murray. 1s. net, with Foreword by Lord Bledisloe.) This book is a reprint of a joint paper read at the meeting of the British Association at Hull.

At the outset tables are given showing the food requirements of the nation and the contribution thereto made by the home producers. The figures, taken as a whole, indicate that about half the nation's food is grown in Great Britain. Certain commodities, however, *e.g.*, milk, potatoes, vegetables and certain fruits are almost wholly produced in this country; on the other hand, our production falls short to the extent of 75 per cent. to 55 per cent. in respect of such articles as wheat, meat, eggs and dairy produce. While, therefore, we can, and do, produce sufficient fresh milk, potatoes and vegetables for our needs, the authors are careful to point out that this self-sufficiency depends on the provision of some effective means of disposing of surplus produce.

In regard to cereals and meat, the possibility is suggested of considerably increased production; "if low wages could still continue to be paid to agricultural labourers, the Norfolk system, improved in its details, would give us a larger food supply than we now have." This the authors recognise to be impossible, and they proceed to examine certain alternative courses having as the central idea—increased output per man:—(*a*) better drainage, (*b*) fuller use of lime, (*c*) a more efficient use of artificial fertilisers, (*d*) the use of improved varieties of crops, (*e*) the eradication or abatement of plant diseases or pests, etc.

The authors seem to favour a cautious and gradual break away from the Norfolk four-course rotation and comment favourably on the Northumberland five-course modification, whereby it is suggested that farmers obtain the same total quantity of roots and corn and "have, in addition, a field of hay."

Finally, a plea is entered for more examples of large scale farming, with specialists in charge of the several departments, as in other important industries, and the paper concludes on an optimistic note derived from the increasing interest displayed in agricultural education by landlords, farmers and farm-workers.

Commercial Tomato Culture.—(The Lea Valley Correspondent of "The Fruit Grower." London: Ernest Benn, Ltd. Price 2s. 6d. net.)

This is clearly a book written by a practical men who has kept in close touch with the development of scientific knowledge. It covers the widest possible range, from choice of site to all the processes of building, heating, soil treatment, growing, marketing, dealing with diseases, and organisation of labour.

The writer aims at high results—sixty tons of fruit per acre—and estimates the cost of steam sterilization at £240 per acre. His advice is good and thoroughly up-to-date, and it must be a most useful little book for beginners in tomato culture who have a sufficient foundation of knowledge upon which to build.

Modern Pig-Keeping.—(H. P. Jacques. London: Cassell & Co.. Price 1s. 6d.) This is a concise little volume packed with useful information clearly set out. It is mainly a collation of material which has appeared from time to time in the Agricultural Press from the pens of well-known breeders and feeders of pigs, tempered by the author's own experience in Western Canada and Rhodesia.

The book opens with a description of the more important factors which have contributed to the success of the Danish system of co-operative bacon factories, and ventures the prediction that before long the enormous importation of bacon, pork, etc., will be a relict of the past. It may, however, be doubted whether the author is fully alive to the part played in this connection by the by-products of the Danish dairy.

In an interesting statistical table it is shown that in 1922 the import of bacon, ham, pork and lard into the United Kingdom from, chiefly, United States of America, Denmark, Canada, Netherlands and Argentina reached the sum of £55¼ million, equal to 27 lb. per head of the population!

The author is a keen, if temperate, supporter of the open-air system of pig-keeping, and his advice to those about to keep pigs is rational and sound. Farrowing and Weaning, Foods and Feeding, Rationing and the Common Pig Ailments, are all dealt with in an interesting and informative manner, and we have no hesitation in recommending this inexpensive and well-got-out little book to all interested in the subject of pigs.

Animal Nutrition.—(T. B. Wood, C.B.E., M.A., F.I.C., F.R.S. London: University Tutorial Press Ltd. 4/6 net.) In a former volume—The Chemistry of Crop Production—Professor Wood dealt with the relations between plants and the air and soil, and showed how crops may derive all the simple substances they need for their nutrition. He now goes a step farther and discusses how these simple substances are built up and stored in the plant and used for the feeding of animals.

It is a fascinating story that appeals to the intelligence rather than the memory, and is in every way a noteworthy addition to agricultural literature. Nothing could be better adapted for the teacher and the student, while the farmer himself will find that a somewhat complicated and difficult subject has been made clear and interesting.

In regard to the question of feeding standards the author briefly reviews the pioneer work of Thaer, Wolff, Lehmann, Lawes and Gilbert, Kellner and Armsby, and arrives at a method of computing rations according to the result that the feeder desires to produce. The farmer will be interested to earn that in many cases his rations are needlessly high in protein, the ingredient usually present in smallest amount in home-grown foods and the most expensive to buy.

The feeding of the various classes of farm animals is dealt with in turn. That of dairy cows, which has of late received the most attention, has more than justified the system suggested, but it seems probable that similar benefits are to be derived from the same system as applied to fattening cattle, sheep and pigs.

No book on the feeding of animals would now be considered complete without some reference to vitamines. The reader will here find the subject dealt with in a manner that appeals to reason and common sense.

* * * * * *

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Chilean Nitrate Committee.—Profitable Cultivation of the Sugar Beet. (11 pp.) London, 1924. [63.3432.]

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Dairying.

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Kentucky Agricultural Experiment Station.—Bulletin 250:—Calcium Metabolism in the Laying Hen. (38 pp.) Lexington, 1923. [63.651.]

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NOTES FOR THE MONTH.

Report of Committee on the Fertilisers and Feeding Stuffs Act, 1906.

THIS Report,* which has just been published by H.M. Stationery Office, is likely to be of interest not only to farmers, but to all who are interested in manufacturing, buying or selling manures and feeding stuffs.

The substance of the Report is contained in Parts II and III. In Part II the Committee sets out the results of its examination of the objections levelled at the Act of 1906. From the farmer's standpoint, the main complaint is that if he calls in the official sampler with no object other than to see that he is getting goods of the quality he is paying for, he may be drawn into criminal proceedings taken by the Local Authority against his supplier, and that consequently many farmers prefer not to use the Act at all. The average farmer, like most other individuals, is anxious to avoid appearance in a police court, even as a witness for the prosecution, and particularly so if the defendant is an acquaintance with whom he has been dealing for many years.

The difficulties of manufacturers and traders are next dealt with. They have always protested against being held criminally liable in respect of goods which have passed out of their control. The Report also refers to the administrative problems that present themselves to Local Authorities in carrying out the provisions of the existing Act. As the Committee points out, it is too frequently the case, at present, that where clear evidence of adulteration or misrepresentation is available, the Local Authority finds itself unable to fulfil all the technical requirements of the Act and Regulations, while where all the preliminary

* Cmd. 2125, price 1s.; 1/1d. post free.

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formalities are complied with, the defendant is able to show that he was not primarily responsible; in either case, trouble and expense are incurred with no corresponding advantage to the agricultural community.

The essential recommendations made by the Committee in the hope of removing the present difficulties may be summarised as follows :—

(1) Farmers should be relieved of all connection with the enforcement of the criminal provisions of the Act. To effect this, the statements in the invoice should be a warranty for civil purposes only, and there should be no prosecutions in respect of samples taken on the farm. At the same time, the period within which such samples must be taken should be extended, and the requirement that notice must be given to the seller should be withdrawn. The result should be a substantial increase in the number of samples taken on the farm, and, if a large number of samples are taken for the purpose of checking the warranty and obtaining compensation for any deficiency, misrepresentation will become less profitable and, therefore, less common.

(2) A description should be applied to every consignment of fertilisers and feeding stuffs sent out from premises where such goods are manufactured, stored or sold, and samples should be taken as often as may be necessary on such premises by authorised officers of the Local Authority. Criminal liability should attach to the application of a false description, but, in view of the great facilities for sampling afforded by the proposed arrangement and in order to avoid possible injustice to sellers, there should be no prosecution except in respect of a sample taken on the premises of the person to be charged. In a word, the official control of these articles should operate at the point of origin instead of after distribution over a wide area and in some cases to remote localities, thus increasing the efficiency of that control in relation to its cost.

(3) The scope of the Act should be defined by means of schedules showing the articles to which the Act applies, the definition of each article, and the particulars required to be given in respect of each in the invoice and in the description applied to the goods The schedules, which, though included in the proposed new Act, should be capable of amendment by Regulation, would allow provision to be made for the peculiar requirements of each class of articles.

(4) An Advisory Committee should be set up to prepare the schedules mentioned, to review the present Regulations and to advise on technical questions arising out of the administration of the Act.

There are a number of other proposals which, though of a less sweeping character, are nevertheless important.

* * * * * *

BRITISH dairying is represented at the British Empire Exhibition, Wembley, by:—

Dairying at the British Empire Exhibition.

1. A modern cowshed, in which are stalled ten deep-milking British Friesian cows.

2. An exhibit of the accommodation and equipment necessary for the handling and dispatch from the farm of milk of the highest hygienic quality, such as milk qualified for sale under the Milk Designations Order as a Graded milk.

3. A Working Country Depôt which illustrates in a practical manner the type of work going on in the farmhouse dairy or in the country depôt where milk is manufactured into dairy products.

4. A Milk Distributing Depôt which illustrates the latest advance in the provision for the handling of milk in a town distributing-depôt where milk is pasteurised, chilled and bottled with the utmost despatch and efficiency.

5. A research exhibit in the Government Pavilion, organised by the Ministry of Agriculture.

The plot of land on which the Working Dairy stands was acquired by the Ministry of Agriculture and placed at the disposal of the National Milk Publicity Council, who undertook that it should be devoted, under their responsibility, to an exhibition of British dairying.

The area available, namely 7,000 square feet, was considered by the Council insufficient to accommodate both the Working Dairy and the Cowshed in which the handled milk is produced. It was therefore decided to devote the whole of the space to the Working Dairy. With the object, however, of providing an adequate representation of milk production and incidentally of British breeds of dairy cattle, the National Milk Publicity Council invited to a meeting representatives of all the British breeds of dairy cattle, at which the Council suggested that the Breed Societies, acting jointly, might rent a piece of land adjoining the Working Dairy, on which to erect a modern cowshed of sufficient size to accommodate such numbers of cows representative of the different breeds as the Societies themselves might decide to have maintained at the Exhibition. The result of the Conference was, however, that the British Friesian Society was the only Society which decided to proceed with the proposal. For this reason the only breed of dairy cattle actually represented in that section of the Empire Exhibition which has to do with British dairying is the British Friesian.

It is a matter for regret that of the several excellent British breeds of milch cattle only one is exhibited. The cows are being housed, fed and milked in accordance with the most approved methods, and those who are interested in the subject should, by examination and inquiry on the spot, be able to obtain useful information.

The milking, together with the handling of the milk, will completely illustrate an approved method of procedure in the case of a farm producing one of the grades of milk specified in the Milk Designations Order.

The small dairy attached to the cowshed shows such milk being bottled for direct distribution from the farm, and also the dispatch in bulk to a Grade distributing centre.

The Working Dairy is divided into two distinct parts (1) the one representing the dairy at the source of production, and (2) the other the dairy which has to do with distribution. The former is being conducted under the direct supervision of an Exhibition Sub-Committee of the National Milk Publicity Council, but the Council arranged with the National Federation of Dairymen that they should organise and conduct the latter.

The home dairy section may be regarded as typical of the work which goes on in a variety of dairies attached to milk-producing farms, and also in a certain measure as indicative of the work of a country dairy depôt in which the manufacture of milk products is the chief business. The dairy is managed by a regular staff consisting of a manager and three trained dairy maids. This staff will be assisted throughout by a rota of experts attending to give a series of special demonstrations (see p. 213).

The daily work of this section is concerned with the manufacture of certain varieties of dairy produce for which this country is renowned, but in view of the wealth of varieties which have their origin in Great Britain it is impossible on each day to provide examples of the manufacture of each. Arrangements have been made, however, for the daily programme to be gradually modified so that every type will, from time to time, be under demonstration. For example, the production of the following commodities is included in the programme: (1) the production of cream for sale—including single, double, Devonshire, Cornish and other types of cream; (2) the manufacture of butter; (3) the manufacture of Cheddar, Cheshire, Lancashire, Derby, Leicester, Gloucester, Dunlop, Caerphilly, Stilton, Wensleydale, Small Holder, soft, cream, and other cheeses.

The whole of these products will be offered for sale to the attending public as soon as they are manufactured, or as they become ripe, and it is hoped that those who visit the Exhibition will make use of the opportunity not only to see the most approved methods of manufacture but to obtain at the source of production examples of British produce manufactured in accordance with the most approved principles.

In addition, the Ministry of Agriculture, at the request of the National Milk Publicity Council, have obtained the consent of certain County Education Authorities to the loan of their expert instructors to conduct special short-period demonstrations in the manufacture of British dairy products. In this manner the specialists will, it is expected, act in accordance with the following programme:—

Period.				
Mth. From.	*To.*	*Special Demonstration.*	*Expert.*
May 1st	17th	Small-Holder Cheese-making	Miss Williams, N.D.D.
May 19th	31st	Cheshire Cheese-making	Miss Bennion, N.D.D.
June 2nd	7th	Derby Cheese-making	Miss Wood, N.D.D.
June 9th	14th	Leicester Cheese-making	Miss Wood, N.D.D.
June 16th	28th	Cheddar	Miss Saker, N.D.D.
June 30th	July 5th	Lancashire	Miss Stubbs, N.D.D.
July 7th	12th	Dunlop	To be appointed.
July 14th	26th	Double and Single Gloucester	Miss Jackson, N.D.D.
July 28th	Aug. 2nd	Soft Cheeses	Miss Matthews.
Aug. 4th	9th	Soft Cheeses	Miss Coward.
Aug. 11th	23rd	Fresh Cream	Miss Nicholas.
,,	,,	Devonshire Clotted Cream	Miss Nicholas.
,,	,,	Cornish Clotted Cream	Miss Nicholas.
Aug. 25th	Sept. 6th	Caerphilly	Miss Taylor, N.D.D.
Sept. 8th	20th	Cream Cheeses	Miss McLeod, N.D.D.
Sept. 22nd	Oct. 4th	Butter-making	Miss Poles, N.D.D.
Oct. 6th	18th	Wensleydale and Stilton	Miss Boyes, N.D.D.

As each special demonstration is in progress there will be on exhibition and sale produce of the type which the process is designed to produce.

Visitors to the Exhibition will have an opportunity of seeing in operation, in that section of the dairy designed to show a modern milk distributing centre, a complete set of equipment designed to handle with the utmost expedition milk which is submitted to pasteurisation, chilling and bottling before it is distributed to the consumer.

The importance which is now attached to cleanliness and expedition in the handling of milk and in the manufacture of milk products are matters of vital concern to the public and are daily becoming more and more realised. It is therefore fitting that the Working Dairy at the British Empire Exhibition should make a point of illustrating in the completest manner possible the most modern methods of conducting the industry.

Co-operative Dairy Schools.

THE Ministry has addressed a circular letter to Local Education Authorities inviting them to consider the desirability of establishing co-operative schools in suitable dairying districts during the coming spring and summer of 1924. The schools are an educational measure preparing for the co-operative organisation of farmers in a district for dealing with "surplus" milk.

In several counties of England and Wales, co-operative dairy schools have been established, and the Ministry of Agriculture is anxious to see the movement extended. With this object, the Ministry is prepared to pay a two-thirds grant under the Educational Grant Regulations to Local Authorities towards the cost of each school, which for the two or three months of its existence is estimated at £75 to £100. The schools already started have often achieved definite success, and have led to the setting up of co-operative societies for the manufacture of cheese and other dairy produce. The Departmental Committee on Prices of Agricultural Produce referred to the advantages to be gained by the co-operation of dairy farmers for the manufacture of surplus milk into cheese, etc., and urged the extension of the scheme for the establishment of co-operative dairy schools. The Ministry holds that the present is an opportune time for the extension, having in view the fact that the Government has lately set aside a considerable sum of money for the express purpose of assisting the development of co-operative enterprise among farmers.

Under the scheme, the initial steps are taken by the Local Authority, which lends apparatus for the purpose (supplied by the Ministry free of charge) and provides a skilled instructor and advice. The farmers of the district agree to supply milk to the school on a strictly co-operative basis, *i.e.*, the price depending on the ultimate sales of cheese, and also to engage a suitable person to assist the instructor with a view to the former becoming qualified to undertake the management of the co-operative factory, if one results from the school. The school is run for two or three months, or until such time as the Local Authority is satisfied that the principles of co-operation have been thoroughly demonstrated. The farmers concerned must then decide whether or no they will carry on the work performed at the school as a properly constituted co-operative society without further assistance from the Local Authority.

Out of 66 co-operative schools held since the scheme was started in 1916, 40 independent societies have been established.

* * * * * *

Model Allotment at the British Empire Exhibition.

TEN square rods of land amount to but a small area, but when used as an allotment even this area brings the cultivator into continued and close contact with mother earth and all her soothing effects on both mind and body. The cultivation of an allotment provides a means of open air recreation of a peaceful and profitable nature within the reach of all classes.

For many it provides supplies of potatoes, vegetables and small fruits in their very freshest state, and in sufficient quantities for a small household for fully thirty weeks of the year, while it is the more attractive because of the flowers it produces for beautifying the home. The wonder, then, is that the number of allotment holders in this industrial country of ours is not larger than the million or so often mentioned. Some of these allotment holders, no doubt, have been associated with the land from youth upwards and are well competent to wrestle successfully with nature and to make the soil yield satisfactory crops without outside help and advice. Most allotment holders, however, are town dwellers who lack these early connections and are handicapped through want of knowledge. Their early training as railway workers, miners, cotton spinners, ship-builders or mechanics, will have given them few opportunities for studying soil tillage or plant culture, but they will have learnt that successful results can generally be achieved by working on correct lines. Urban allotment holders therefore look for reliable information from the Ministry and from County Agricultural Education Committees.

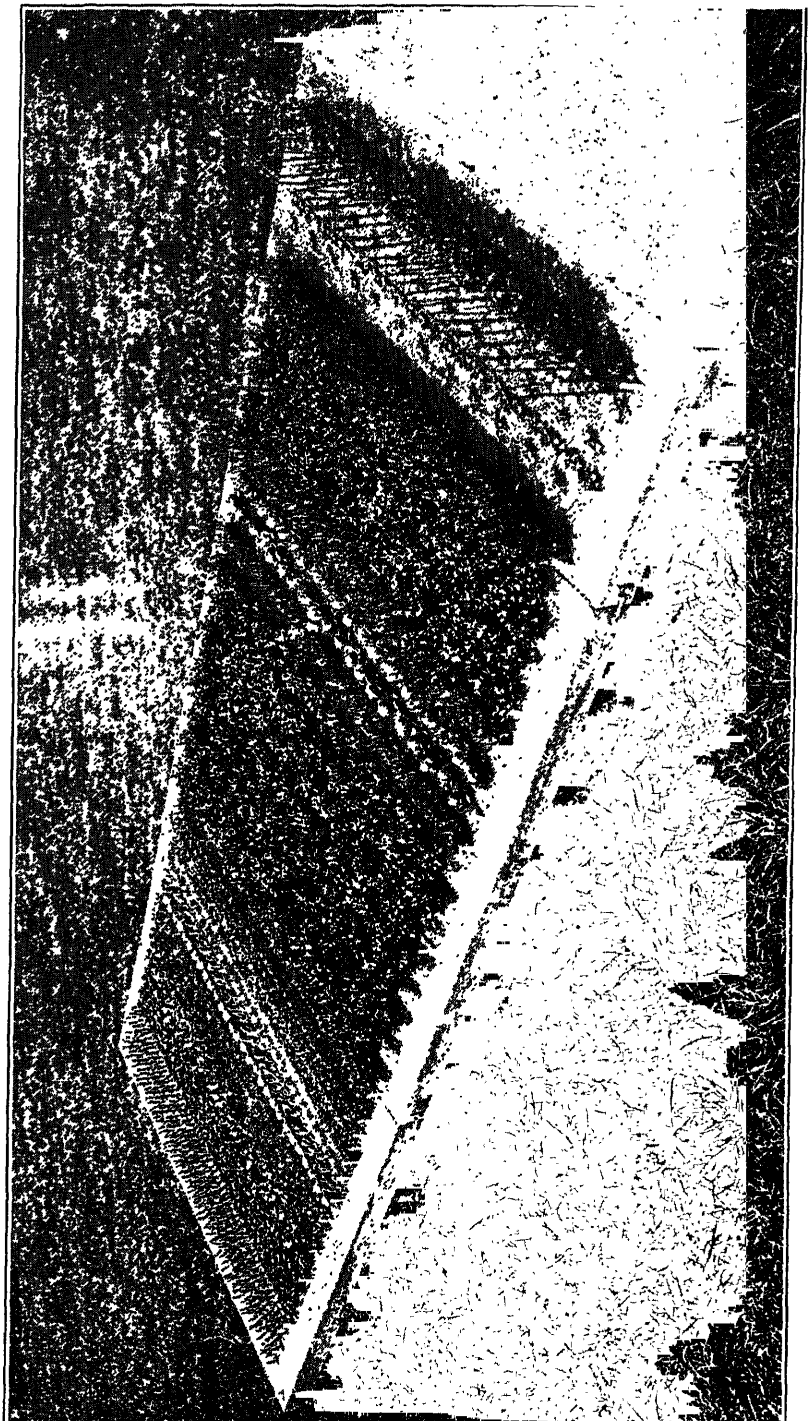
The allotment movement is regarded as so important that the Ministry considered it desirable to construct a model of a demonstration 10-rod allotment on a scale of $\frac{1}{2}$ in. to 1 ft. for exhibition at the British Empire Exhibition at Wembley. The construction of a model to show growing plants is never easy, and the difficulties increase as the scale diminishes. For this model it was necessary to find diminutive plants similar in growth to the

allotment vegetables and one-twelfth the size. Within limits this has been done; lichens to represent lettuce; box (*myrtifolia*) for potatoes; box (*incarva giganteum*) for cabbage and Brussels sprouts; *Lycopodium* for peas; *Ficus* for runner beans; laurel for dwarf beans; rushes for onions; flax for leeks; *Cupressus* for carrots; *Potentilla* for turnips, etc. These plants had to be killed and the leaves and stems fixed to secure permanent specimens, then coloured with dyes approximating to the colours of the growing plant which they represent. This has been done for all plants of the 10-rod allotment, and the model is now exhibited in Case K of the research exhibit in the Agricultural Gallery of the Government Pavilion at Wembley. The illustrations herewith give some impression of the general "lay-out" of the allotment. The model is divided into three parts, which can be re-arranged to show the proper annual rotation of the crops.

The 10-rod allotment must be treated in an intelligent way, and cropped in a sound manner under a proper rotation of crops, in order to ensure good tillage, make the most economic use of plant foods, and guard against damage by plant pests—which is likely to occur wherever the land is cropped continually with the same classes of plants. The cropping must be carried out on a settled plan which, with slight variations, must be persistently followed year by year.

The best plan of cropping to give satisfactory results has been carefully considered by experts on several occasions, and their decisions are incorporated in the Ministry's Leaflet, No. 315 (*Suggestions and Chart for the General Cropping, Manuring and Cultivation of Allotments*). This leaflet has been very popular, for no fewer than 110,000 copies have been distributed since its introduction in September, 1920.

In order to assist further, the Ministry arranged, in recent years, for some County Committees to establish demonstration allotments to show the system of cropping and the quantity of food that could be produced from them. On the demonstration allotments in the Counties of Middlesex, Bucks and Kent, the following average crops were produced:—potatoes 326 lb., parsnips 60 lb., turnips 60 lb., beet 46 lb., carrots 40 lb., shallots 76 lb., peas 20 lb., runner beans 55 lb., French beans 60 lb., broad beans 24 lb., Brussels sprouts 30 lb., savoys 35 lb., cabbage 50 lb., kale 42 lb., cauliflower 20 lb., spinach 20 lb., lettuce 20 lb., rhubarb 30 lb., marrows 28 lb.



SOIL IMPROVEMENT: FERTILISERS AND THEIR USE.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

THE value of artificial fertilisers was discovered at Rothamsted eighty years ago in a few extraordinarily simple pot and field experiments made in the first instance by Lawes and afterwards by Lawes and Gilbert. The famous Broadbalk experiment is perhaps the best known of these. It was well known that farmyard manure increased the yield of crops, but no chemist was able to say why: some considered the effect was due to the combustible or organic part of the manure on the principle that this was of like nature with the plant; others supposed that only the ash or mineral constituents were effective, while others again considered that nitrogen compounds played a part. To distinguish between these rival hypotheses Lawes and Gilbert laid out four plots in the Broadbalk wheat field; to one they added farmyard manure, to a second they gave the ashes from an equal quantity of farmyard manure, to a third they applied a nitrogen compound in addition to the ash constituents, and the fourth was left unmanured. Had the ash constituents been the real fertilising agents the second plot should have given as good results as the first; had the organic matter been the effective fertiliser none of the plots should have equalled the first; if, however, the fertilising value lay in the ash constituents *plus* nitrogen compounds then the third plot which received this mixture should have yielded as well as the one receiving farmyard manure.

The experiment was conclusive; the results were:—

Lawes & Gilbert experiment with Wheat, Broadbalk Field, 1843-4.

	Yield of Grain. Bush. per acre.
Farmyard manure, 14 tons per acre	22
Ashes of 14 tons farmyard manure	16
Mineral manures and nitrogen compounds	26¼
No manure	16

It thus appeared that the fertilising value of farmyard manure lay in its mineral constituents *plus* nitrogen compounds. Now this was an interesting scientific discovery, but Lawes saw that he could develop it on the practical side; it was not necessary to burn farmyard manure for the purpose of obtaining the ash constituents; these could be obtained in large

quantities from other sources while the nitrogen compounds could be obtained from gas works in the form of sulphate of ammonia. Accordingly Lawes and Gilbert laid out plots to test these artificial fertilisers on the various farm crops, and the plots have furnished and continue to furnish such valuable information that they are maintained to this day with only such changes as Lawes and Gilbert themselves made in the course of their work.

Since the original discovery of Lawes and Gilbert, chemists have been busily engaged in making an extensive and well classified list of substances which can be used as fertilisers. These substances fall into three groups; nitrogenous, phosphatic and potassic. Each of these groups, besides contributing in a general way to plant growth, has some definite specific effect on the crop which the farmer can often use to his advantage.

Nitrogenous Fertilisers.—The first with which we deal is the nitrogenous group, and includes nitrate of soda, nitrate of lime, sulphate of ammonia, muriate of ammonia, urea, and where used in that form, cyanamide. All these fertilisers increase the rate of leaf growth and so produce larger leaves and stems; they also induce a greater formation of green colouring matter, giving darker green crops. Farmers take advantage of these properties in several ways. Leafy crops such as cabbages and mangolds are liberally treated with nitrogenous manures in order to obtain as much growth as possible. Again, these manures are extremely useful where quick growth is wanted. Producers of early potatoes in Cornwall use dressings of nitrate of soda which would stagger the grower of main crop varieties; as much as 10 cwt. per acre is used, and the dressing is justified on the ground that it brings the potatoes more rapidly up to market standards and therefore assures the grower the high reward given to the man soonest ready. On ordinary farms this rapidity of growth is advantageous in dealing with certain insect pests; wherever the trouble can be minimised by making the plant grow more rapidly a dressing of nitrogenous manure should be tried. A further case where this effect is valuable is after a long cold winter when the plant is backward. It is true of crops as with human beings, that the child is father to the man, and a backward plant in late spring has little chance of growing into a heavy-yielding plant unless it is given some help.

As between the various nitrogenous manures there are certain properties which are sometimes of use and sometimes disadvantageous to the farmer. Nitrate of soda has the advantage of being one of the most rapid in action, of being easily obtainable, easily

handled, and well known to farmers. It is especially useful for hay, mangolds, cabbages, and for spring dressings of wheat and oats after a long winter. It is applied at the rate of 1 to 2 cwt. per acre and comes into action at once. Care is necessary in using it on heavy land, since the clay is liable to become deflocculated and to assume a sticky condition, but this trouble can be obviated by using a mixture of nitrate of soda and neutral sulphate of ammonia, applied immediately after mixing; not stored.

Nitrate of lime is also very rapid in action. It can be used on the same crops and in the same way as nitrate of soda; it is advantageous where the soil is deficient in lime, and, so far as the writer's experience goes, it has no ill effect on heavy soils.

Sulphate of ammonia is the most suitable nitrogenous manure for second early and main crop potatoes, on which it can be used in considerable amounts, even 3 or 4 cwt. per acre having proved profitable. It is very useful as a spring dressing for winter corn crops, and as a nitrogenous manure for barley. For other crops it is almost as effective as nitrate of soda and it is usually distinctly cheaper. Care is required in using it on land deficient in lime as it reacts with a certain amount of this constituent; one cwt. of sulphate of ammonia puts out of action about $\frac{3}{4}$ cwt. carbonate of lime. This property might prove of definite advantage on alkali soils where nitrogenous manures are wanted.

The other two nitrogenous fertilisers are new and not yet within the experience of the ordinary farmer; muriate of ammonia is quite promising; it is of the same character as sulphate of ammonia but is less suitable for dry conditions; it apparently behaves equally well, however, under a rainfall of 30 inches or more. It should not be mixed with muriate of potash for use in the eastern or midland parts of England; there is no visible harm either to the appearance of the fertiliser or of the crop, but on our present knowledge it appears that the efficiency of the fertiliser is lowered by the excess of chlorine.

Urea is a promising fertiliser and, being much more concentrated than any of the foregoing, it would be very useful where freightage is costly. It should, so far as we know, be drilled with the seed, and not be used as a top dressing, otherwise it is liable to a certain amount of loss.

Phosphatic Fertilisers.—These include superphosphate, the basic slags and the mineral phosphates. All have the effect of inducing root growth, hence their value for swedes and other

root crops. The quickest in action is usually superphosphate owing to the ease with which it dissolves in water, and it often produces striking effects. The most remarkable demonstrations in this country of its value are found in the Fens, where growers use large quantities, and it is usually the most effective fertiliser they have. Throughout the eastern counties there occur many other instances. In the Dominions perhaps the most striking effects are seen in South Australia, where very small dressings of superphosphate produce remarkable increases in the wheat crop. Larger dressings, however, give no better results.

In addition to improving the root development superphosphate also hastens the ripening processes, a very valuable action in cold, wet, or backward regions. It is used in the high Yorkshire wolds to expedite the wheat crop. These two effects render superphosphate very valuable on heavy arable soils, or on soils liable to be wet where the young plant has some difficulty in any case in getting a start, and where the ripening processes are apt to be unduly delayed. On the other hand, the need is less felt on dry sands where root growth and ripening go on quickly enough, and where indeed any hastening of ripening may reduce the yield. This contrast is seen in two experiments made at Woburn with barley in 1922, one on a low-lying rather heavy loam apt to be wet, the other on a light sand. The yields of grain per acre were :—

		With superphosphate.	*No superphosphate.*
At Woburn ;	low-lying rather heavy loam	44.7	39.9
Do.	light sand	34.6	38.4
In Suffolk ;	light sand	21.6	27.9

At Woburn the withholding of phosphate was harmful in the case of the heavier soil but not on the lighter sand. A similar result was obtained on a light dry sand in Suffolk.

Among the most striking effects of phosphates are those on poor grassland on heavy soils—land which produces low yields of hay per acre and has only a small stock-carrying capacity. Basic slag, and more recently finely-ground mineral phosphates, have given remarkable results which are too well known to need description. It does not seem to matter what type of slag or of phosphates is used on poor grassland; with all types Dr. Scott Robertson obtained great improvement in Essex, and when costs and all other factors were taken into consideration it was sometimes difficult to say which phosphate had proved most profitable. The low-

soluble fluor-spar slags, however, were uncertain in their action. Some of his results are as follows:—

Weight of hay at Butterfields, Latchingdon. Manures supplying 200 *lb.* P_2O_5 *per acre, sown December,* 1915.

	Hay, cwt. per acre. Average 5 yrs. 1916-20.
No manure	20.5
Basic Bessemer slag	29.4
Gafsa rock phosphate	27.3
Open-hearth (fluor spar) basic slag	28.9
Open-hearth basic slag high citric soluble (1)	28.9
Open-hearth basic slag high citric soluble ...	32.3

When, however, one comes to somewhat better grassland it is less easy to obtain these striking effects; so far as we can tell at present the better the land the higher should be the grade of slag used. In the Essex experiments the rock phosphate was somewhat less effective than slag on the sweet soils, although there had been less difference on sour soils. as shown by the following table:—

Comparison of results on Sour and Sweet Soils.

Centre.	*Lime requirement of soil.*	*Ph. value of soil.*	*Rock phosphate.*	*Basic slag.*
	per cent.		Average cwt. per acre.	Average cwt. per acre.
Sour Soils:				
Tysea Hill ...	0.29	5.7	30.5	30.9
Martin's Hearne	0.27	6.1	28.8	30.7*
Lambourne End	0.45	—	28.0	30.6*
Average ...	—	—	29.1	30.7
Sweet Soils:				
Latchingdon ...	0.03	7.8	27.3	29.4
Saffron Walden	0.00	—	38.1	40.9
Horndon ...	0.00	7.7	19.5	23.4*
Average ...	—	—	28.3	31.2

*Open hearth high-soluble slags.

The contrast between the effects on poor and on good land is shown in the following Rothamsted figures, where it is seen that both the high- and the low-soluble slags, and the finely-ground mineral phosphates, have improved the yields of hay on the poor land, but that none of them has increased the yield on the better land, although the high-grade Bessemer slag had improved the quality of the herbage so that there was a gain in live weight of sheep.

Poor Grassland; 11 *cwt. hay only per acre.*

	1922. Cwt. per acre.
Control	10.9
Open-hearth slag, 90 per cent. soluble... ...	16.5
" " 30 per cent. soluble... ...	18.7
Gafsa phosphate	18.8

*Better Grassland; 1-1½ tons hay per acre.**

	Yield of Hay, cwt. per acre. 1921.	1922.	Live weight increase in sheep, lb. per acre. 1921.	1922.
Bessemer slag	24.3	17.3	59	143
Open-hearth, high-soluble	23.9	16.6	43.3	112
Control	—	—	59	116
Opén-hearth, low-soluble	26.5	21.1	67.3	123
Gafsa	25.4	22.5	88	107
Control	26.4	20.1	90	115

*The slags used on the grazing land were not identical with those used on the hay land, but they were of similar types.

Potassic Fertilisers.—The third great group of fertilisers is the potassic, and these are of special importance for the cow keeper and the potato grower. Part of their value to the cow keeper lies in the fact that they greatly increase the yield of mangolds and the quantity of sugar contained therein. The gain in yield has been repeatedly shown: 1 cwt. sulphate of potash or its equivalent in kainit has given 2½ or more tons per acre additional yield; the gain in sugar is periodically demonstrated at Rothamsted by analyses of the crop. Another feature of great importance to the dairyman lies in the stimulus potassic fertilisers give to the growth of clovers in land laid in for hay, and in temporary seeds mixtures. Lastly, the important consideration arises that 75 per cent. of the potash contained in the cow's food passes into the urine and is commonly lost to the farm; it must therefore be replaced. The cow keeper can use sulphate, muriate, kainit or potash salts, whichever appears to be cheapest.

To the potato grower potash is a recognised necessity, and it is already used in quantity for this crop. Wherever much dung and nitrogenous manure is used for the purpose of increasing the yields, it is necessary to balance with potash, otherwise both yield and quantity suffer. The muriate and sulphate give approximately the same crop increases, but the sulphate is the better for quality. Some of the compound manures used by potato growers do not contain sufficient potash; the county organisers should be consulted in cases of doubt.

Need for Organic Matter.—In the early Rothamsted experiment with wheat quoted at the beginning of this article the yield from the mixture of mineral manures and nitrogen compounds—in other words from complete artificial manure—was somewhat greater than from farmyard manure. A similar result was obtained with barley. The success of Lawes and other farmers with artificials led chemists to think that these manures gave the crop everything necessary, and even

to assert that they were better, cheaper, and more certain in their action than farmyard manure. Subsequent experience at Rothamsted and elsewhere has shown that this is not the case. Artificial manures cannot maintain the fertility of arable land as well as dung, and it is evident therefore that dung supplies something to the soil or the crop that artificials do not. Considerable investigation is going on at Rothamsted to find out wherein the difference lies. Already interesting chemical and physiological results have been obtained, and it has been shown that certain chemical substances contained in farmyard manure have a stimulating action on leguminous crops which artificials do not possess. Whether it will be possible to prepare these substances separately and put them on the market as Lawes did with the constituents he studied remains to be seen; the facts are being carefully ascertained and fully studied.

Again, it is well known to farmers that dung has a beneficial effect on the tilth of soil. Measurements at Rothamsted have shown a saving of over 22 per cent. on the power consumption required for ploughing dunged as compared with unmanured soil. Other measurements have shown a gain up to 5 per cent. or even more in moisture content of the soil as the result of dunging—an invaluable help in a dry season. Here again the facts are being studied at Rothamsted and the causes at work are gradually being discovered; until this is done it is impossible to tell the farmer much that he does not already know, or to put the facts in such a way that inventors can use them. Further attempts are being made to increase the supplies of organic manures on the farm by green manuring, the preparation of synthetic manure direct from straw, and in other ways. Finally, close investigation is being made of cases where artificial fertilisers fail to give the expected return, for it must always be remembered that the crop needs other things besides food, and unless these are supplied it cannot make full use of artificial fertilisers.

* * * * * *

HAYMAKING.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

ABOUT six million acres of permanent and rotation grassland in England and Wales are annually mown for hay. The hay crop thus occupies about the same total area as all the corn

crops together. In districts with low or moderate rainfall the harvesting of the crop may in most seasons be carried out without great difficulty. In other districts—generally where the acreage to be secured is greatest—the process is subject to great hindrances owing to weather conditions and shortage of labour, so that frequently a high proportion of the nutritive matter grown is lost, the remainder being secured at a great expense per unit.

Feeding Value of Hay.—Hay is not so nutritious as the dry matter of pasture grass. It cannot be regarded merely as pasture grass without water; for whereas pasturage is in itself a complete food and capable of supporting cows in full milk, hay requires to be supplemented with other feeding stuffs which enrich the ration in digestible matter, especially protein. An important difference between the dry substance of pasture grass and that of hay is that while 100 lb. of the former yield 56 lb. of productive nutriment (starch equivalent), 100 lb. of the dry matter of good hay yield only 36 lb., and of poor hay only about 20 lb. A milch cow can extract all the nutriment she requires in a day by consuming about 27 lb. of pasture dry-matter, a quantity well within the capacity of a Shorthorn of average size; but to obtain the same quantity of starch equivalent from good hay, she would have to consume 42 lb. of hay dry-matter. This quantity would exceed her digestive capacity, but even if she could consume and digest that weight, her energy would obviously be diverted from her main function of making milk.

Very good hay tends to approach in character the dry matter of pasture grass, while bad hay has many points of resemblance to straw. As affecting the nutritive value of hay, the principal factors more or less within the farmer's immediate control are the time of cutting and the process of harvesting.

Time of Cutting.—It is established knowledge that leaf is more nutritious than stem and that as a grass plant approaches botanical ripeness the digestibility and productive value of its dry matter diminish. Hay made from ripe grass that has lost its leaf and seed, is merely straw. This knowledge lies at the foundation of the well-known rule as to cutting as soon as the majority of the grasses are in flower. In practice the rule is very commonly applied only in respect of the first field to be mown; the other fields may be ripe, dead ripe or seeded, according to the progress made in harvesting previous fields. Where a considerable acreage has to be dealt with, good

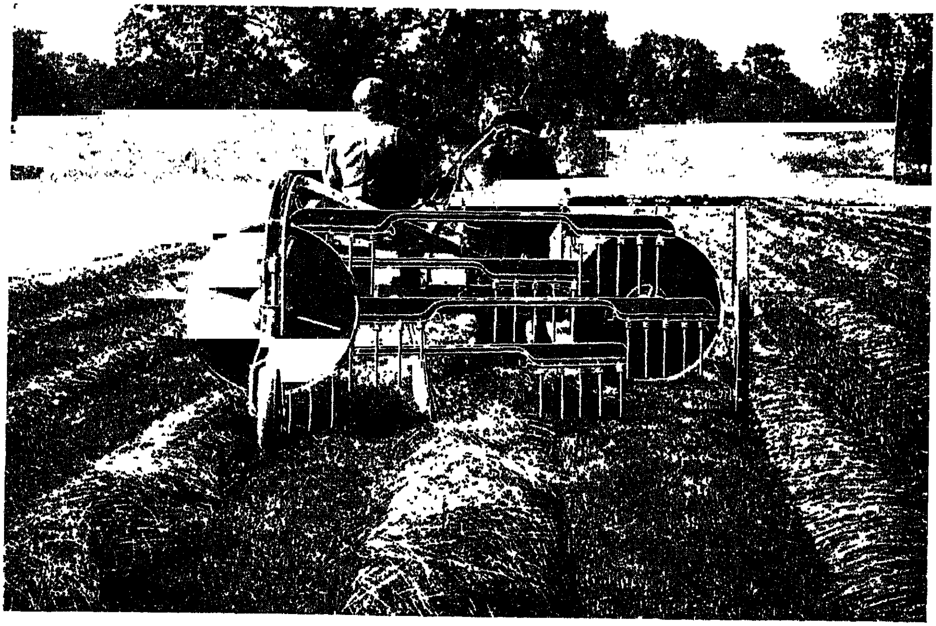


FIG. 1.—Side-Rake adapted for Swath-Turning.
(*From "Farm Implements and Machinery," by courtesy of Messrs. Benn Bros., Ltd.*)

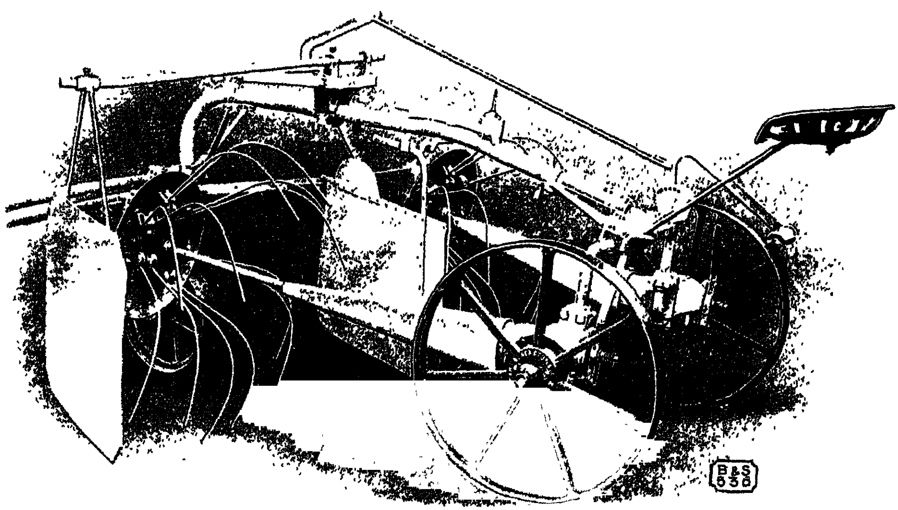


FIG. 2.—Swath-Turner, adaptable for Side-Raking.
(*By courtesy of Messrs. Blackstone & Co., Ltd.*)

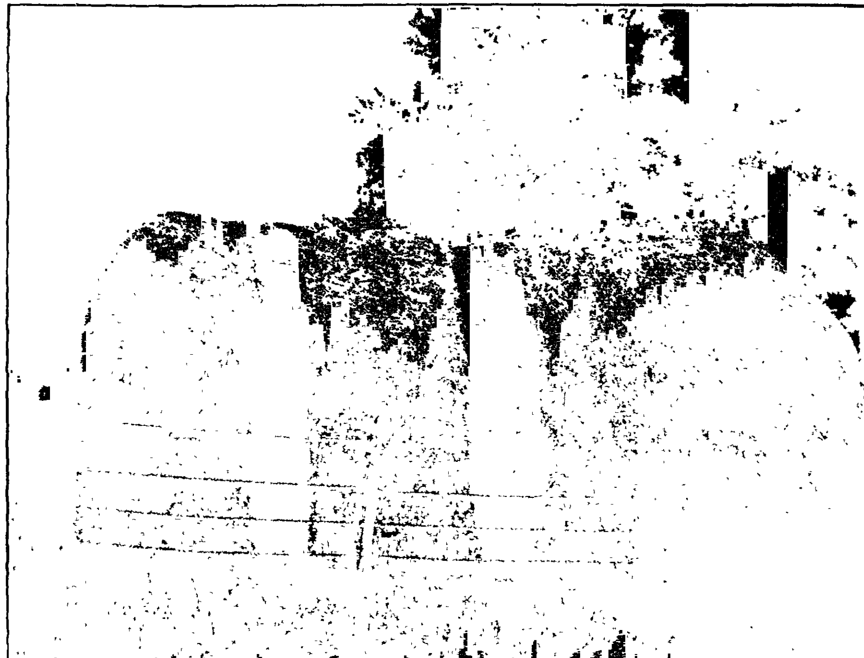


FIG. 3.—Over-heated Stack cut to promote cooling.

weather at the end of June should not be allowed to pass unutilised in the hope of gaining a few cwt. increase in yield per acre. The writer has frequently heard farmers admit the advantage of making an early start; but never has he heard a regret in respect of commencing too soon.

Early mowing involves some loss of weight of produce and a greater loss of bulk, but the additional weight and bulk obtained by later cutting represent matter of little nutritive value. Early-cut grass is also more watery and more fermentable than mature herbage; but it very often happens that there is a spell of fine weather at the end of June, whereas August is often wetter. The loss of nutritive value attributable to over-ripeness and to weathering usually greatly exceeds that due to cutting too early. The early-cut field also throws up a better aftermath, which often comes in for feeding at a very opportune time, and if the practice is continued, it becomes free of certain weeds that usually infest late-cut fields.

It has been proved by feeding trials with dairy cows that hay made by carefully drying short leafy grass has the same nutritive value as fresh grass. Cattle feeders also know that a feeding pasture will fatten stock only while the sward is kept reasonably short; if the herbage is allowed to run up and become stalky, it no longer possesses the nutritive strength necessary for fattening. These two facts emphasise the importance of early mowing and suggest the desirability of experimental work to ascertain whether the increased nutritive value of hay made from two or more cuts of shorter herbage could be secured at an economical cost. In some parts of Europe, particularly Holland, it is common practice to mow the meadows twice or even three times in the year, manuring accordingly. In this country, however, farming opinion is against the mowing of aftermath; that of late-cut meadows would be difficult to harvest; and usually it is needed to help the pastures. As regards the effect on the future condition of the meadow, it is immaterial whether the aftermath be grazed off, or mown off, provided that if mown the land receives a proper return in the form of manure. In one case with which the writer is familiar, the aftermath of over 100 acres of meadow land has been mown every year since about 1890, the produce being made into stack silage with the aid of compression wires.

Economics of Haymaking.—The main object in haymaking is to secure at the least possible cost the greatest possible

amount of the nutriment grown. Were it not necessary to count the cost, then probably air-drying under cover would best attain the object; and with the aid of a current of warm air, good hay could be made in any weather. Similarly, some of the methods ordinarily practised in humid climates result in securing a greater proportion of the nutriment present in the grass crop but at a higher cost than the methods usually applicable in more favoured countries. However, the idea of reducing costs at harvest time must not be carried to the point of omitting to perform operations that are desirable under the conditions prevailing at the time.

The cost of growing, cutting, carrying, stacking and thatching hay, under Midland conditions, is about £3 10s. per ton; to this must be added the cost of the "making" process, which is a variable item, but small in relation to the other costs. In good weather the making may involve only twice swath-turning and side-raking at a cost of about 3s. 6d. per ton. Under certain conditions, however, it is desirable, for instance, to put hay into cock, instead of leaving it overnight abroad or in windrow, and on the next morning to throw the hay out, ted it, and again gather it into windrow. The cost of this additional work is again about 3s. 6d. per ton; but it may prevent the deterioration of the hay to the extent of over £1 per ton, and it may actually involve the least labour and expense in the end. Under other conditions, coiling may be an unnecessary expense and interrupt the work of carrying other hay which is ready to stack.

Principles of Haymaking.—Grass ready for mowing contains 70 to 75 per cent. of water; hay that has completed its "sweat" contains about 15 per cent. Until the proportion of moisture has fallen to the latter figure, the material is subject to fermentation of one kind or another. The principal aim in the process of haymaking is to reduce the moisture content of the grass to about 20 per cent. If at the time of stacking there is still 25 per cent. of water in the hay, rapid fermentation may take place and if the stack is large the temperature may attain a high figure involving considerable loss of digestible matter, if not actual ignition. Several agents play a part in the work of drying out the excess moisture:—(1) the sun; (2) the air; (3) fermentation or "sweating."

Sun Curing.—Light crops may under sunny conditions be "made" by mere exposure of the cut grass to bright sunshine,

The hay after cutting is, if necessary, scattered abroad with a tedding machine to expose the greatest surface to the sun. While sunshine is appreciated as an aid to haymaking, it is possible to injure the product by continuing the sun-curing until the hay is quite dry: the result is a bleached, odourless hay from which the fine and more nutritious parts, having been made brittle, are apt to break away. Clover and lucerne are very readily injured by over exposure to strong sunshine, and accordingly the swaths should not be tedded abroad under a bright hot sun, but only turned gently and subsequently collected ready for carting or cocking.

Air Drying.—So long as the atmosphere is not saturated, the cut grass will continue to yield up its moisture, even in the absence of sunshine. The rate of drying depends upon the dryness of the air, its movement (wind), if any, and the surface of grass exposed. The drying power of the atmosphere may be measured with a simple hygrometer: one thermometer has its bulb kept constantly moist, the other bulb being kept dry. When the two thermometers register the same temperature, the air is saturated and it is futile to ted or otherwise move hay in the hope of helping on the drying.

The greatest surface of grass is exposed to the air when it has been scattered abroad; and when the sun is not too strong, this tedding abroad is the best means of accelerating drying on a calm day. It is only when there is sufficient wind that the hay dries more quickly in windrow or loose swath than it does when spread out over the whole cut surface of the field.

The disadvantages of having the hay spread out are that in this condition it is most liable to injury by untimely rain, while if left abroad over night it cools and catches more dew than does hay in row or cock. If cocked while still enclosing warm air, the hay collects little dew; the movement of sap from stem to leaf continues during the night, and drying proceeds the more rapidly when the cock is opened out next day. A well-made cock of meadow hay will turn rain, but rough heaps may be wetted right through to the bottom. Coarse stemmed hay such as clover or lucerne may become soaked through in the cocks, as occurred on many farms in 1923. Some American farmers avoid this danger by using covers for the heaps.*

In Scandinavian countries and in other parts of Europe, air drying is facilitated by "coiling" the half dried grass loosely upon vertical stakes bearing cross pieces, or on a framework,

*See *Covers for Corn Stooks and Hay Cocks*, this *Journal*, July, 1922, p. 378.

such as might be imitated by leaning and fixing together a pair of sheep hurdles in the shape of an A. Another device adopted for the same purpose where timber is less plentiful, is constructed as follows:—7-ft. stakes are driven into the ground in a row, about 1½-2 yards apart; a rope is stretched from one to the other, hitched on each stake about 20 in. above the ground, and loaded with hay; then the rope is again stretched and hitched from stake to stake 18 in. above the first, and this is similarly loaded; and so on until 3 or 4 layers have been put up.* Hay built on to drying racks is comparatively free from injury by rain or dew, while it continues to dry during the fine intervals. There is comparatively little loss of nutriment in the making of hay by this process; but some discretion is required in the matter of the condition of the grass when put into the rack: no rain or dew must be present and it must be already about half "made." This method is specially good for clover and lucerne hay.

Fermentation or "Sweating."—Most farmers make use of a limited fermentation in the stack to complete the drying of the hay and at the same time to improve its aroma. To ensure satisfactory results the hay must be stacked before the plant cells are quite dead, and the 5 to 10 per cent. excess moisture still present must not be that of rain or dew. Hay is ready to stack when the crop is uniformly dry to such a degree that it rustles in the hand, the leaves have become somewhat brittle, the nodes in the grass stems are shrivelled, and the coarsest stems will crack when doubled over. If the hay is dead—from over-maturity at cutting or protracted harvesting—it must be dried more thoroughly than usual before stacking; otherwise it is liable to become bitter or mouldy, as a result of a "cool" sweat.

The actual degree of dryness necessary for safe stacking depends on the size of the stack. Comparatively "gay" hay containing 40 to 50 per cent. of moisture may be put together in small stacks in the open, if well consolidated; and this fact is widely applied in some countries, including the northern parts of Britain, as a means of economising good haymaking weather.

In some places early stacking in sweat ricks is intentionally adopted for the production of "brown" hay. The process is as follows:—the grass is dried in the usual way until it is about a day short of the condition that would be requisite if it were being put into an ordinary large stack or barn. Usually about three days' air drying are given, clover or lucerne of course

*See *Method of Drying Hay in Sweden*, this *Journal*, Oct., 1907, p. 417

requiring longer than grass; the partially "made" hay, free from dew or rain, is then put together in conical sweat ricks on a bottom about three yards across, the material being put on in layers of about 10 in. thickness and each layer very firmly and uniformly trampled down from the centre outwards. The ricks are built in the field, a bottom of straw being laid down to keep out ground moisture, and the top is raked down and secured with bands. In two or three days the temperature rises appreciably, and about the third week reaches its maximum of 140 to 160 deg. F., the excess moisture meanwhile steaming off. From this point the temperature falls and at the end of the third or fourth week the hay is ready to be put into the barn or the large stack. The product is a slightly browned hay of agreeable aroma and good condition.

The advantages of the above method are (1) that the hay is secured against the weather a day or so sooner, this day often being a critical one; (2) the work of leading home and stacking is deferred until the entire crop has been saved; and (3) the risk of firing or overheating is reduced. As regards labour considerations, it may be mentioned that, by the use of a collector for sweeping the hay together to form the sweat ricks and a hay-bogie or a rick-lifter for carrying home, considerable economy in hand labour can be effected.

Over-heating of Stacks.—Bacteria play an important part in the heating of stacks. The initial rise in temperature is due to the respiratory activity of the still living grass cells, this warmth making conditions favourable to the bacterial fermentation which follows. A certain bulk of hay—about a load—is needed to conserve the heat sufficiently to ensure a warm sweat, and as already stated, the hay must be still alive at the time it is put together.

If the fermentation continues at only 60 to 100 deg. F., which sometimes happens when damp hay lies long in cocks unmoved, the result may be a bitter or mouldy product, these temperatures favouring the growth of the coli bacillus and the mould fungi. The most desirable hay organism—*B. calfactor*—comes into action at 104 deg. F. and is killed by temperatures above 167 deg. F.

When the mass of "gay" hay put together in one rick exceeds about three loads, there is risk of the temperature rising undesirably high, the heat generated not being able to escape fast enough. The charred part of an overheated rick built on the ground occurs below the centre point of the stack; a raised

staddle by permitting the heat to escape downwards, as well as in other directions, is a means of checking overheating. High temperatures involve considerable loss of the soluble constituents of the fodder and a reduction of its digestibility; but in an ordinary large stack or barn there is more serious danger when the heart of the mass continues to rise above 160 deg. F. In this case the fermentation is passing from the biological to the chemical type—the bacteria having been killed. The danger is more imminent when about five weeks after stacking the rick continues to sweat and smell and the size of the mass shrinks unusually. The writer has had some experience of the use of the hay borer, by means of which cores about 5 in. in diameter are cut down into the heart of the stack, forming chimneys for the escape of hot, moist vapour. Such experience has been favourable to the device; but whatever method of cooling a hot stack be adopted, it is desirable that it be put into operation before the temperature in the heart of the rick has reached 170 deg. F.

Losses in Haymaking.—Ordinarily 10 to 20 per cent. of the nutriment present in a crop of grass is lost in the process of converting it into hay, but the loss may exceed 30 per cent. The losses fall partly on the visible portions of the fodder—leaf, fine stems and seeds—but even to a greater extent on the soluble and readily digestible internal constituents. The causes of loss are as follows:—

1. *Respiration.*—The grass does not die immediately after mowing but continues to respire and consume its cell contents. The loss from this cause may amount to over 10 per cent. of the weight of the dry matter of the crop, the greatest losses occurring when, owing to bad weather, the cut grass must lie many days in a moist condition. On this account it is undesirable to mow down a greater area than there is a fair prospect of being able to secure within a week.

2. *Shedding.*—As a rule there should be no seed to shed. The loss of leaf and other fine portions of the fodder is due to over-drying, especially sun-curing, and to rough treatment of the crop. The tedding machine may offend in this particular, for which reason it is considered an unsuitable appliance for the making of clover or lucerne hay, or mixtures containing much clover.

3. *Leaching.*—Untimely rain, falling on half-dried grass spread over a large surface, may remove a large proportion of the sugar and the soluble ash constituents of the fodder. Swathes and windrows, and especially well-made coils, are capable of resisting to some extent the action of rain.

4. *Over-Heating in the Stack.*—Mow burnt hay contains little digestible carbohydrate, and the digestibility of its proteins is very low. Losses up to 20 per cent. of the nutritive value of the hay have been recorded as due to over-heating in the stack.

There are other losses which affect the palatability of the fodder perhaps to a greater extent than its starch equivalent. Over-made hay is not liked by stock, although if there has been no leaching or shedding, the nutrient matters may have been well preserved. Mouldy fodder is almost invariably rejected, unless masked by chaffing and mixing with other foods of an attractive nature. Dew and rain, if present in the hay at the time of cocking or stacking, encourage the development of moulds to a much greater extent than the same amount of moisture in the form of natural cell sap.

Hay-Harvesting Machinery.—Sixty years ago the grass crop was mown with the scythe, and most of the drying operations were carried out by hand labour; the men worked while the horses stood idle until the hay was ready for carrying. One man was needed for every 5 acres to be " got." Nowadays the area harvested per man is about 15 acres, machinery having increased the output per man by about 200 per cent.

The smallholder who grows and secures his own hay must have a mower, a " haymaker " and at least a slide-rake for rowing: he usually borrows a dump rake for cleaning up. This minimum equipment can be amplified, according to requirements and the area involved, by the addition of a swath-turner, a side-delivery rake, a loader, a sweep, a horse-fork or an elevator, and where the sweat-rick method is adopted, either a hay bogie or a rick lifter. The practical farmer does not, however, buy every machine that he would like to possess or that would be useful to him: unlike the manufacturer, the farmer uses a machine on only a few days in the year, hence the overhead charges on farm equipment are heavy in relation to their services. Some examples of the circumstances which should be considered in selecting hay-harvesting tackle are explained in the following paragraphs.

Haymakers.—Where there are 100 acres of hay to harvest, there is sufficient employment for the three machines—swath-turner, tedder and side-rake. With such an area the ordinary rate of progress is about 6-8 acres per working day: thus while the swath-turner is operating on the grass mown a day or two previously, the tedder is breaking open and tedding the swaths turned the preceding day, and the side-rake is engaged in a third field airing the hay and putting it up in larger rows ready for cocking or carrying. The advantages of this machine over the dump rake are very distinct.

Where the acreage concerned is only half the above and the rate of progress only 3-4 acres per day, one of the three machines could be dispensed with: the tedder is almost indispensable and the side-rake is invaluable. Fortunately there are good machines which combine the functions of swath-turning and side-raking. One type is primarily a swath-turner, and may be preferred for work on uneven land. The other is primarily a side-rake; this may be recommended for level surfaces, while it has a third capacity, viz., tedding.

Loaders and Sweeps.—The loader is most useful where sufficient labour is available to operate mechanical stacking tackle. It renders best service where the haymaking staff comprises more than seven men. If the hay has to be cocked, the loader is not applicable; but in this case the labour of pitching and loading and even that of unloading is appreciably reduced. The sweep rake offers the cheapest and most expeditious means of carrying where the crop is stacked in the field. For similarly clearing small areas, the simple hay collector is invaluable.

Unloaders.—Where the acreage of hay and corn is sufficient to justify the outlay, an elevator is to be recommended. For medium sized farms, however, the horse fork may be a great help, affording relief in the heaviest task—pitching on to the stack—and removing the most common source of delay in the carrying operations.

Conclusion.—For the conduct of farm operations in general and for hay-harvesting in particular, recipes can be of only very limited service—applicable only under certain conditions. It is otherwise with principles, an understanding of which enables the farmer to adapt his methods to his varying circumstances and requirements and to draw more valuable lessons from each season's experience.

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THE PROGRESS OF SCIENCE AND MACHINERY IN HORTICULTURE.

W. G. LOBJOIT, O.B.E.,

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MODERN commercial horticulture in England may be said to be the growth of the last sixty years or so. From the comparatively simple occupation of old-time nurserymen and gardeners,

it has developed into a highly specialised industry, tuned up to the highest point of efficiency by the tonic of the competition of products drawn from every favoured zone of the earth's surface, and grown by workers in every stage of industrial development from barbarism to high civilisation. No other section of cultivators of the soil has lent so ready an ear to those qualified to express scientific ideas and to explain the processes by which the ideas could be put into practice. No other branch of the parent tree of agriculture presents so attractive a field for the activities of the organiser nor so inviting an atmosphere for experiment.

Cultivation.—In dealing with the soil, machinery has been brought into use for securing the deep tillage which is so essential to intensive cultivation, from the deep scarifier worked by steam tackle to various forms of sub-soilers drawn by horses or tractors.

The tractor is now a familiar machine on intensively cultivated holdings from 50 acres upwards. Preparation of the soil for a crop can, by this means, safely be deferred until weather conditions are favourable for tillage. Small mechanically-driven implements are also much in use among crops and nursery plantations.

Science has been brought into co-operation in the manuring of the soil. On many undertakings, regular analyses are taken and the considered prescription of the scientist applied. The analysis required by law to be given with every sale of manure is becoming better understood, and growers are becoming increasingly familiar with purchase by unit value.

The use of soil sterilisers, both chemical and mechanical, the latter by steam heat and dry heat, is common practice in the glasshouse industry. In the open, soil fumigants are increasingly used in the culture of root crops.

Plant Breeding.—The laws of hybridization have been closely studied and put into practice, to the great improvement of types and increase of varieties. From the aristocratic orchid to plants that a quarter of a century ago were only considered as weeds, the careful and sympathetic attention of the horticulturist has developed varieties and combinations that our grandfathers would have deemed to be beyond the bounds of imagination.

Much has been done in the breeding of improved types of vegetables and fruits. It is significant that the first oranges to be planted in Florida were bred in an English nursery. Many of our favourite vegetables are introductions from warmer climes;

the development of types that will be happier in our climate is proceeding, though much ground remains to be covered.

The problem of supplying the home grower with varieties of apples to compete, in attractiveness and in the habit of consistent good cropping, with some well-known kinds from overseas, is not yet solved, but in our first-class nurseries and in research stations there are batches of seedlings, the product of scientific crossings, from among which any day there may appear the desired combination.

The cucumber has been developed both in prolificacy and shape of fruit, and also in ability to resist disease, so that the produce comes upon the market with almost the regularity of the product of a factory, and the English cucumber dominates the trade in many parts of the continent of Europe.

The tomato has been developed from the unattractive corrugated fruit, to the present even-sized, round fruit grown on a plant of high productive capacity. Twenty-five years ago the tomato was an object of curiosity; to-day it is a staple article of diet.

Similar developments have taken place with grapes and other hothouse crops. Important developments are also on the way in the case of black currants and plums.

Heating.—Perhaps in no department of horticultural activities has there been more application of science and machinery than in the nurture of the various crops. The protection against the austerities and vagaries of our climate afforded by a glass roof has been persistently developed. From the erection of thirty years ago, which was more wood than glass, to the present-day greenhouse—with its fine adjustment of dimensions to the amount of atmospheric movement desired, its thin, yet strong, bars placed wide apart, and its large panes of clear glass and small lap—there is all the difference between the primitive and the complete. Glasshouse installations with from ten to twenty acres completely covered with glass are now common, while if one adds the area occupied by movable frames and other temporary forms of covering there are installations with a hundred acres or more under cover.

In the matter of heating, too, the horticulturist owes much to co-operation with the scientific engineer. The boilers of to-day give much increased heating from a given amount of fuel, while electric impulsers accelerate the flow of water to pipes of more than one diameter and to differences in level; while heating by high-pressure steam has received its attention and has its advocates.

Plant Diseases and Pests.—In intensive cultivation there is more opportunity afforded to the attacks of plant diseases and pests, and a greater field for their rapid multiplication than in the more extensive forms of cultivation, and here the preparations of the chemist and the use of machinery for their application have been remarkable in their development. By means of spraying with toxic preparations both dry and liquid, and by means of fumigation with cyanide, nicotine and other preparations, fairly complete control may be established over many plant diseases, the uncontrolled spread of which would make the cultivation of certain crops economically impossible. The provision of machinery for these various applications has afforded a fine field for the inventor. The opportunity has been so well exploited that the grower, whatever the size of his undertaking, however varied his requirements, can have a choice of appliances; whether it is the production of a fine mist spray for liquids, or the dusting of powder; whether by manual, horse or motor power.

The installation of permanent power plants in orchards and in undertakings for intensive cultivation enables the grower to make the fullest use of the discoveries of the chemist. The use of electric power and light for promoting growth in greenhouses has received attention, but is not yet beyond the experimental stage.

Fruit Stocks.—Investigations into the root formation of the stocks used for budding and grafting have been carried out at East Malling and Long Ashton, and the results have been applied extensively in fruit plantations. The cultivation of apples and pears upon dwarfing stocks enables the scheme of plantations to be either of cordons or of dwarfs as fillers, with standards or half-standards as the ultimate character of the plantation, and has reduced the waiting time for economic returns from a fruit plantation to from three to five years instead of from six to ten years.

Grading and Packing.—The intensive cultivator has not only availed himself of the assistance of science and machinery in the production of his crop, but has also advanced in the no less important department of marketing. The tomato and cucumber growers in this country first realised the meaning of the attention given to grading and packing by exporters from overseas, and what preparation to attract the eye of the purchaser meant to the home producer. More than fifteen years ago the cucumbers and tomatoes grown in the Lea Valley and at Worthing were

standardised both as regards grading and packing, and the standards then fixed for these products have now become general.

The movement in favour of scientific grading and packing is now in full swing and promises within a short time to cover the whole field of horticultural production. Machines for grading tomatoes are already being used commercially. Various types of grading machines for apples are on the market and many are in actual operation, while plans are maturing for the establishment of a co-operative grading and packing station for apples in East Anglia.

In the matter of transport full advantage has been taken of modern developments, and tons of produce that formerly had to undergo the double handling necessitated by railway transport are now taken to various markets by motor lorries owned either by growers or by salesmen, within a radius of 50 miles from the market; while the railway companies, by the introduction of more scientific methods for the handling of perishable produce, are steadily lessening the damage factor incident to long distance transport.

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THE STUDY AND TEACHING OF AGRICULTURAL ECONOMICS.

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IN some countries it has long been recognised that in the general study of economic phenomena insufficient attention has been paid to the economics of agriculture, and that the results of the general studies of economic organisation cannot be applied to agricultural conditions. Amongst the countries which have recognised this fact may be mentioned the United States of America, Switzerland and Denmark, for in all these countries a highly developed organisation for research in agricultural economics now exists; and in the United States the teaching of agricultural economics has reached an advanced stage. In most of the universities facilities are provided for taking subjects in agricultural economics in degree courses leading to agricultural or to social science degrees, and in several of the most important of the universities post-graduate degrees are awarded for work in either agricultural economics or rural sociology, or in a combination of these subjects. Amongst these may be mentioned Cornell and Wisconsin Universities. Moreover, the study and teaching of agricultural economics and of rural social science has

had a profound effect on the teaching of both agriculture and social science in the whole of the United States, and is now exercising a considerable influence on public policy in regard to problems of land, agriculture, and rural social organisation.

Institutions Teaching Agricultural Economics.—In England the first facilities for study of agricultural economics were provided in 1913 when the Institute for Research in Agricultural Economics was established at Oxford by the University and the Ministry of Agriculture supported by the Development Commissioners. During the war, special developments of study, particularly the study of the costs of production of farm produce, occurred, but these disappeared in 1920. During the last year provisions for the study of the *business management of farms* were made by the Ministry of Agriculture in connection with colleges and universities. Economic Advisory Officers, who will study the systems of farm management in their respective areas and take part in teaching principles of economic farm management in their institutions, were appointed at Oxford University; Cambridge University; Leeds University; University College, Reading; and Wye College, Kent. Minor provisions for the study of special problems of farm management have also been made at other institutions.

Before these later provisions for the study of agricultural economics were made several colleges or universities had made a practice of providing some teaching in economics for students in agricultural degree courses. This teaching was chiefly limited to economic history and general economic theory, for organised knowledge was too scarce to admit of the teaching of agricultural economics *per se*. Amongst institutions providing teaching of this character may be mentioned the University College of Wales, Aberystwyth; Leeds University Agricultural Department; School of Rural Economy, Oxford; School of Agriculture, Cambridge; and Wye College, Kent. The School of Rural Economy, Oxford, included in subjects required for the Pass Degree, those of Economic History of Agriculture, Economic Theory, Costs of Production and Marketing of Farm Products, Estate Management, Local Government and Administration. Amongst some of these subjects the students could choose, but they were required to take some economic subjects. Henceforth, it appears certain, students for degrees in agriculture in all universities will be required to take certain economic or social subjects of study, and the tendency will be to develop these departments of research and teaching.

Although progress is being made in teaching agricultural economics or rural social science subjects to students of agriculture, no advance in the opposite direction—of teaching agricultural economics or rural social science subjects to students of general economics or the social sciences—has anywhere been made. Yet there is sufficient divergence between economic and social phenomena in agriculture and rural life, and such phenomena in other industries and in urban environments, to justify their special study and also a special branch of teaching. Indeed, the time has now arrived when one or more universities could safely make provision for special study and teaching of agricultural or rural economics and of rural social science leading to an Honours or to a Post-Graduate Degree. Such a course should be open, and would have appeal, to students who have taken a Pass Degree in Agriculture, for which the course had included a preliminary study of economics, or to students having taken a general agricultural course and who wished to specialise; also to students who had taken a general course in economics and social science and wished to specialise in the rural aspects of these sciences.

Two Fields of Study.—The general scope of the study and teaching of agricultural economics covers two more or less distinct fields, viz., (*a*) the factors in the internal management of the farm which determine the productivity of the enterprise and the remuneration of those who are engaged in it, whether workers, farmers or landowners; and (*b*) the external factors which determine the course of production which is possible or desirable, and those which determine the prices of farm products. In other words, the two fields are those of the Economics of Farm Management and the Social Economics of Agriculture. Conditions of organisation, remuneration and life on English farms are determined not only by the conditions on the farms themselves, but also by forces which arise in other industries or within the agricultural industry of other countries. Therefore, it is not sufficient to study the economic phenomena of farming organisation apart from general economic and social phenomena connected with the industry over a wide geographical area.

Indeed, the scope and methods of study which past study and teaching of agricultural economics have shown to be necessary may be stated in this way:—

(1) Economics of Farm Management	(a) Accounting method. (b) Statistical method. (c) Survey method. (d) Experiment.
(2) Social Economics of Agriculture	(a) Geographical method. (b) Historical method. (c) Statistical method. (d) Survey method.

Farm Management.—The study of farm management includes amongst other things the study of costs of production of crops and live stock, and the factors which lead to high or low costs, whether technical or social. It also includes the results in profits and/or wages of organising types of cultivation or animal husbandry on a large or small scale; the results in gross and net production of large and small-scale organisation; and the social results, such as the effect on the family of different forms of organisation.

The most important results which the study of farm management, especially by accounting and statistical methods, has yielded, and is still yielding, are those showing the requirements in labour, food or materials for various processes. In such matters as the labour requirements per crop-acre, or dairy cow, in man-days and horse-days per acre or year, the study has yielded such results as will soon make it possible to state extreme variations and their causes, together with the average or standard requirements. The establishment of standards of this character will be of immense value to farmers, especially such as are developing experience, in that they provide criteria for the results of their own management.

Again, when results have been collected under sufficiently varying economic conditions and over sufficient geographical area, it will be possible to do some reliable cost estimating for guidance in making contracts which apply to goods to be produced in the future, as in the case of milk. Studies have shown remarkable constancy in certain proportions of costs due to various items, and when the price of items in cost, *e.g.*, labour or food, can be forecast, fairly reliable estimates of total costs can be made. It is, however, in the establishment of standards of requirements that accounting in particular holds out great hopes of practical assistance in internal farm management.

In its human aspects the study of farm management itself verges on the study of the social economics of agriculture and rural life. But the study of internal management also verges on the study of geographical or social phenomena in other countries, especially in relation to the systems and costs of market-

ing farm products, and the prices of such products in the home market. The social economics of the industry include all subjects which would be included in a general study of the social economics of all industries. But it may be said that the study of the social influences affecting the organisation of farming is of practical and financial, as well as of cultural, value. In a study of British farming, knowledge of the recent history of agricultural development in other countries, notably in the United States, the self-governing Dominions, and in the countries of northern Europe is of both cultural and practical value. Similarly, in the study of development of types and methods of English farming, knowledge of geographical influences in other countries as well as in this country is of cultural and practical value.

Methods of Study of the Economics of Farm Management.—As regards the economics of farm management *the accountancy method* has been used to discover principles and details of economical production of crops and stock. It can also be used to discover principles and details of division of income within the industry.

The statistical method is used for the same purposes when less accurate detail is required, or when information is required over a greater area or a greater period of time than can be covered by accountancy.

The survey method is also used when complex influences have to be studied in relation to internal conditions on farms, and when large areas have to be covered. It is particularly useful when geographical or social influences have to be correlated with farming conditions.

By *experiment* is meant trial of methods under controlled conditions, and although this has scarcely yet been used in this country it has been used in other countries, and may be used here when sufficient knowledge has been obtained to make possible isolation of factors and definite trial of limited methods.

Methods of Study of the Social Economics of Agriculture.—As regards the social economics of agriculture, *the methods of geography* are important in the study of distribution of types of crop or animal husbandry in relation to soils, climate, contours, transport and markets.

The historical method applied to any period is useful for cultural purposes, but for practical purposes its application is chiefly to the last 170 years of agricultural development in Europe and the European settlements in other continents. In relation

to the development of the science and practice of agriculture, it yields valuable results for the guidance of the farmer and the executive or administrative official.

The statistical method is applied in the study of the social economics of agriculture as in other social sciences, but there is still a vast field for the practical application of statistical methods to the study of economic phenomena in agriculture, especially in the relationship of the agricultural systems of exporting countries to those of countries like our own.

The survey method is being applied with a large measure of success to obtaining information partly geographical, partly technical and partly social in character. It is yielding information at once valuable to the farmer and to the constructive social engineer.

Economic Farm Management.—The branch of the general study which is most advanced in this country is that of economic farm management. Even in this sphere the study of systems and costs of marketing has made little advance. In this subject persons primarily interested in transport and commerce have large interests, and in many cases would welcome development of facilities for study and teaching. For the study of the social economics of the industry no university or institution has yet made adequate provision. The Ministry of Agriculture has stimulated, and will continue to stimulate, the study of internal economic management of farms, but it is necessary that an academic institution should stimulate the study of the wider aspects of the subjects. One aspect which would immediately repay study is that of marketing, or agricultural commerce.

Openings for Students.—As interest in the general subject of the economics of agriculture is rapidly developing, and the value of knowledge of economic phenomena is becoming recognised, it is practically certain that students of these subjects will find openings for careers. Indeed, in the United States of America, where the study and teaching of agricultural economics has had a great influence on farming policies and on agricultural social policies, the demand for men trained in this sphere has been equal, if not more than equal, to the supply. In this country it is becoming recognised that men required for administrative posts connected with agriculture and rural life should receive an economic and social training definitely related to their sphere of activities rather than a purely technical training in agriculture.

Rural Sociology.—A subject closely related to agricultural economics is that of rural sociology, or the study of social phenomena in the rural environment. No attention has yet been paid to this study by any academic institution in this country, although, again, the study has advanced to a definite position in several American Universities. Such work as has been done in this country has been personally and privately undertaken. Many persons may doubt whether the development of special facilities for study or teaching in rural social science is either necessary or desirable, but there can be no doubt that in this predominantly industrial and urban country the study of social phenomena tends to be limited to the study of such in an urban environment. Nor could it be doubted that the study of rural social phenomena now needs a special stimulus.

A university which now has no very close agricultural connections, but which has close connections with industry and commerce, could make for itself a special sphere in the development of the study and teaching of the social sciences related to agriculture and rural life. The welfare of persons in other industries and commerce is closely connected with conditions of agriculture, not only in this country, but in those countries with which they trade. Some studies of agricultural economics would be of practical value to them, in addition to adding to their knowledge and appreciation of general economic and social phenomena. The study of the economics of the industry, moreover, cannot be carried on without technical knowledge of processes in the production of crops and live stock, but approach from the economic and social side enables the non-agriculturists more quickly to appreciate the importance of ruling conditions in the industry. In addition, the teaching of agriculture itself in this country is taking a decidedly economic trend. The present practice tends more and more to inductive studies of farm management, and of varying practices of crop and animal husbandry as a basis for agricultural teaching. Agricultural economics now provides a practical link between the study of social and other sciences. It also provides a link between the farming and the industrial or commercial communities. It is a subject which can be linked up with existing studies in universities in which social studies are carried on, but in which there is no special study of agriculture. The methods used in the study of agricultural economics are such as provide a wide training and discipline in general scientific methods, and the scope of the subject is sufficient to include matter of both practical and cultural values.

THE GROWING OF FIELD PEAS FOR STOCK FEEDING.

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THE field pea as a corn crop is principally grown in the Eastern Counties of England—Lincolnshire, Suffolk, Yorkshire and Essex showing the largest acreage. The area under peas grown for corn has dropped since the war from 132,249 acres in 1919 to 94,970 acres in 1923. This area includes both peas grown for stock feeding purposes, and blue or marrowfat peas, the grain of which is hand-picked, put up in cardboard packages, and used mainly as a table vegetable and for soup.

Varieties.—The most important variety of blue peas is *Harrison's Glory.* This variety is grown chiefly for packing, but in times of good demand is often marketed in the pod like garden peas. If, owing to bad harvest conditions, insect attack* or other cause, the grain is of inferior quality, or if the price is low, they may have to be used for stock-feeding. Harrison's Glory is hardier than most garden peas, but not so hardy as the usual stock-feeding varieties. Of the latter the following may be mentioned :—

Early Minter or Norfolk Dun.—Straw medium length, pods fairly long, grain a pure dun colour. Ripens very early and so usually suffers less than others from aphides or plant lice. Seedsmen offer strains selected for special earliness, longer pods and suitability for autumn sowing.

Maple or Partridge.—Straw long, pods numerous, grain light brown, blotched irregularly with whitish yellow, ripens late. Sometimes in considerable demand as food for pigeons. Maple peas, like all long-strawed varieties, are useful for smothering rubbish, but, on the other hand, are not usually fit to cart until wheat harvest. This precludes the chance, offered by earlier peas, of ploughing and cleaning the land before harvest. Maple peas resist attack by aphides fairly well, but the variety is regarded by some as rather a light cropper, especially in a wet season, when it runs to straw.

Black-eyed Susan.—Straw long, grain large and dun-coloured, with black eyes. Ripens in mid-season and consequently is more exposed to aphides than the early dun. Usually considered a heavy cropper.

Eights and Nines.—Straw fairly long, pods long, grain tightly packed in pods, greenish. Ripens fairly early. Is considered by some growers a very valuable variety.

* Regarding insect attacks the following leaflets should be consulted:— No. 19, Pea Weevil (*Sitones*); No. 150, Pea Beetle (*Bruchus*); No. 48, Pea Thrips (*Frankliniella*).

Other varieties which may be mentioned are *Prussian Blue*—a small blue pea grown for feeding, and *Wisconsin Blue*—a variety introduced from America. A white field pea is also sometimes grown. Distinct varieties have been introduced by the Swedish Plant Breeding Station, but they have not yet been fully tried in England.

Variety Trials.—Very few trials to test the relative yielding capacity of different varieties of field peas have been conducted in this country.

In a test conducted some years ago, in Suffolk, practically identical yields were given by Black-eyed Susan, Norfolk Early Dun or Minter, and Swedish Solo. The year of the test, however, was not a good pea year.

In a test conducted some years ago, in Suffolk, practically ducted, also in Suffolk, in which Hazel Dun—a selection of Black-eyed Susan—gave 200 stones of grain per acre, whilst the three varieties, Maple, a selected Early Norfolk or Minter, and another selected Dun pea, all gave about the same yield—170 stones per acre. Two Swedish varieties gave smaller yields. Too much reliance must not be placed upon the results of a single experiment, but these figures confirm the general view that Black-eyed Susan is a heavy-yielding pea.

Climate.—The best conditions seem to be a spring and early summer in which the weather is neither hot nor cold. A heavy rainfall, except on light land, is not desirable. In East Anglia in 1922 the extremely hot weather in May or June was probably responsible for an insect (aphid) attack which practically ruined the crop.

Soil.—Peas are generally and probably rightly supposed to do best on a good light loam well supplied with lime. Still they may be grown with success on a wide variety of soils. For instance, in dry districts they will thrive on extremely stiff clays, if these are well drained. Not only should such heavy land be under-drained with pipes or moles, but the furrows should be kept scoured and water furrows provided to the nearest ditch. Peas, like most other farm crops, find bad drainage fatal in a wet season. On undrained wet and heavy land a wet May or June will make them go yellow and ruin the crop.

On heavy land, if well drained, however, field peas are much less likely to go yellow and perish with wet than the more delicate marrow-fat and table peas.

Place in Rotation.—Peas usually follow a white straw crop, taking the place of beans or clover. Thus, in the Norfolk four-

course rotation the cropping would be (1) roots, (2) barley or oats, (3) beans, peas, or clover, (4) wheat. Thus peas or beans would come on the same land once in eight years.

This rotation may, of course, be modified in various ways, but it is probably safest and best not to grow peas on the same land oftener than once in six to eight years. If grown oftener, there is greater risk of failure.

Peas, like all other leguminous crops, are able to assimilate the free nitrogen of the air and store it up in their roots, stems and leaves. For this reason they tend to enrich the soil in nitrogen, and a good crop is regarded as a useful preparation for wheat, barley or oats. The amount of vegetable residue left in the soil by a good crop of peas is, however, in all probability not so great as that left by a good crop of beans or clover, hence the land after a crop of peas is not usually in quite such a high state of fertility as after beans or clover.

Peas have, on an Essex farm, been grown successfully after clover. The clover stubbles, after providing a considerable amount of winter grazing, can be ploughed in winter in plenty of time for the peas. It is claimed that two leguminous crops in succession have more effect than a single leguminous crop in enriching the land for the wheat which follows; also that peas succeed better after clover than after a white straw crop. This method may be justified when peas of a valuable kind, such as Harrison's Glory or table peas, are grown, but with ordinary field peas it is better to follow the usual rotation. The method of taking peas after clover may be of extra benefit to one field; the usual method spreads the effect of the leguminous crops over a double area.

Field peas, in many of the drier districts, were found, especially on heavy land, to be one of the best, if not *the* best crop to grow on the grassland ploughed up in the war years of 1917-18. The land was simply ploughed up in winter and allowed to weather, and the peas drilled as early as possible in the spring. Very few failures of the pea crop, even on poor soil, were recorded on land thus treated. When ploughing up grassland it is important to use a skim coulter in order to bury all grass thoroughly, and, in spring, to roll well with a heavy roller before drilling, so as to leave no hollow spaces below the inverted turf. The soil should be repeatedly harrowed with not too heavy harrows, so as to work up the surface to a kindly tilth without bringing up to the turf. Disc harrows are very useful for this purpose.

Time of Sowing.—Peas for stock feeding are usually sown in spring, in early districts as soon as possible after the 1st of January, February being perhaps, the commonest month. While it is an advantage to sow peas as early as soil and weather conditions allow, they may, if the land is too wet for early sowing, be sown successfully in the north and midlands as late as April or even the first week in May, but in East Anglia, owing to the frequent droughts in April and May, such late sowing is very risky. In recent years, autumn sowing, preferably in November, has been found successful. The risk of frost is balanced by the fact that the peas are earlier than when sown in the spring, and hence better able to resist insect attacks in May and June.

Manuring.—Only a few experiments have been conducted in this country on the manuring of field peas. Farmyard manure is occasionally used. Often no manure at all is used and this, on really good soil in a high state of fertility, is probably the safest proceeding; over-manuring of any kind, especially with farmyard manure, tends to produce straw at the expense of pods, particularly with the long-strawed varieties.

On most ordinary soils, however, an application of manure will be desirable, especially when peas are grown after a cereal. As previously mentioned, peas, like other leguminous crops, are able to obtain their nitrogen from the air, and there seems very little doubt that in most cases an application of nitrogenous manure is unnecessary.

The few field experiments of which the results are available indicate the value of phosphates and potash.

At Saxmundham Experimental Station in Suffolk on heavy clay land, peas and beans mixed were grown on a piece of old grassland ploughed up during the war. The mixed crop was the first crop obtained after the grass. Part of the field had received a dressing of 10 cwt. per acre of basic slag of high grade and solubility applied to the grass in 1904 and again in 1912, whilst the other part had received nothing. The crop of mixed beans and peas obtained in 1919 on the slagged part was 40 bushels per acre and 62 cwt. of straw, whilst the unmanured part gave 29.7 bushels of mixed beans and peas and 42 cwt. of straw.

At Bramford Experimental Station in Suffolk peas were grown in 1905 and 1906. The soil was poor and light, but exceptionally rich in available phosphates. None of the manures had a very striking effect upon the crop, but on an average of two years 1 cwt. of muriate of potash used alone gave an increase

of 3 bushels of grain and 2 cwt. of straw over no manure, whilst it also gave a similar increase when added to nitrate of soda and superphosphate.

In pea growing districts an application of phosphates, and, on light soil, of potash also, is becoming increasingly common.

The following are suggested dressings for land in an average state of fertility:—

(1) Land poor in lime should receive a dressing either of lime, chalk or limestone, or other form of carbonate of lime, a considerable time before sowing the peas.* It is practically useless to sow peas on land seriously deficient in lime.

(2) On Heavy Land—6 cwt. 30 per cent. basic slag, 4 cwt. 30 per cent superphosphate per acre, or equivalent quantities of other phosphatic manures.† Basic slag is to be preferred on heavy land poor in lime.

(3) On Light Land—2 cwt. 30 per cent. superphosphate and ¾ to 1 cwt. muriate of potash,‡ or its equivalent of other potash manure per acre. On light land poor in lime, 2 cwt. basic superphosphate or 1 to 1½ cwt. steamed bone flour per acre should be used instead of superphosphate.

Manures such as superphosphate, steamed bone flour, and muriate or sulphate of potash should be applied a few days before drilling, before the land is harrowed down.

Basic slag or low grade potash salts such as kainit should be applied to the ploughed ground several weeks before the crop is sown.

Cultivation.—When growing peas after another arable crop the cultivation is very simple. Provided the land is clean, one ploughing is usually sufficient, especially on heavy land. On light land, or if rubbish is present, a second ploughing may be given. It is important, especially on heavy land, that the final ploughing should be finished before Christmas in order to allow the land to be weathered by the winter frost and rains so that a good, kindly seed-bed may be obtained at the time of planting. It is also probable that peas succeed better on a stale furrow, *i.e.*, on land that has been ploughed and allowed to lie some time before drilling the peas.

As soon as the land is dry enough in early spring—if possible in January or February—the land is worked down by harrows in the same way as for other spring corn, and the seed is

* See Leaflets Nos. 170 (*The Use of Lime in Agriculture*) and 385 (*Lime and its Uses on the Land*).

† See Leaflets Nos. 267 (*Basic Slag*) and 394 (*Phosphatic Fertilisers*).

‡ See Leaflet No. 335 (*Potash Fertilisers*).

NOTE:—Farmers should apply for advice on any point to their County Agricultural Organiser. See Leaflet No. 279 (*Technical Advice for Farmers*).

drilled at the rate of $2\frac{1}{2}$ to 4 bushels per acre, the quantity varying in different districts. The distance between the rows also varies in different districts, but 9 in. to 12 in. is a useful distance. Where the land is not very clean, the wider distance is often used, as it permits of more thorough horse-hoeing. Probably 9 in. is an average width.

Many growers advocate harrowing to destroy seedling weeds as soon as the peas are up through the ground and the land is dry enough. The harrowing of peas, however, requires discretion or the crop may be damaged. When 2 in. or 3 in. high they are horse-hoed once or twice, and hand-hoed. Certain types of horse hoes have very light harrows following the tynes of the horse hoe. These serve to kill small seedling weeds and also to remove soil cast up by the horse-hoe tynes that has covered up the peas. Any docks present should be removed when the land is soft and before they run to seed, a docking iron being used to assist in pulling up the roots.* If the docks are forward enough to be seen they are better removed before horse-hoeing, as that operation cuts off the tops of the docks and leaves the roots to shoot up again.

Peas are rarely successful in a struggle with weeds, and should never be planted on foul land. Further, every care should be taken, while the crop is young, to keep it clean by the methods above described. The straw, at a comparatively early stage, becomes entwined (or as it is called "joins hands"), and when once this has occurred it is impossible to carry out any further weeding owing to the damage that would be caused by walking, however carefully, through the crop.

Later in the season, towards harvest time, peas lie flat down on the ground, and this allows various weeds such as thistles, goosefoot, etc., full access to light and air: hence, unless the land is fairly clean to start with, it is apt to become very weedy before the crop is harvested.

Harvesting.—When sown early and when the variety grown is an early one, peas are one of the first crops to ripen, and they may often be safely in the stack before the other corn is fit to cut.

As a general rule they are cut and made up by hand, either with a pea-hook, or with a scythe. The pea-hook or pea "make," which resembles a sickle, but has only a slight curve in it, is on the end of a shaft, and in the hands of a skilful man does good work. Opinions differ amongst practical men as to which tool, the pea-hook or the scythe, is more satisfactory for

* See Leaflet No. 251 *(Common Weeds)*.

cutting peas. Whether hook or scythe is used, the peas are made up into wads or small heaps at the time of cutting.

Field peas are often also cut with an ordinary grass mower or clipper, to which have been attached " lifters " or pea guards similar to those used for laid corn. These lift up the peas in front of the knives, and prevent the pods from being cut off. When peas are cut in this way it is necessary to have the cut peas removed outwards before the machine comes round again. The work of removal is facilitated if a reaper attachment is fixed to the grass mower so that the peas are left behind the machine in small heaps like sheaves. Some large growers use a pea-harvesting attachment which is fixed behind the cutter bar of the grass mower. This causes the freshly cut peas to slide on one side in such a way that room is left for the horses and grass mower to pass by when next they come round, and the removal of the peas by hand is unnecessary.

Mr. A. M. Rope, of Leiston, who grows about 60 acres of peas every year, has used this attachment very successfully for the past 3 years. He fixes it to an old grass mower, pea lifters being also fixed in front of the cutter bar. An old mower is used, as the work is rough and would soon render a new one unfit for grass cutting. Mr. Rope finds the attachment works well if the crop is quite ripe and dry and the land solid—a man and a pair of horses will cut 7 acres a day and do good and clean work. This attachment is especially useful where a large area of peas is grown as under such circumstances the labour available may not be sufficient to take up the whole crop by hand.

Occasionally the implement known as the hay " toppler " is used in harvesting peas. Only half a breadth is taken at once, the horse walking quite close to the unpulled peas. The peas are broken off against the roots by the toppler. Some farmers speak highly of this method of harvesting peas, and there is no doubt that satisfactory work may be done if all the peas lie one way.

Peas are often harvested with an ordinary horse rake, which must be of strong construction. The horse walks just outside the edge of the peas, with one wheel and nearly half the rake running on the peas. When half the rake is nearly full it is lifted up and the peas removed out of the way with a pea-hook or " make." The horse afterwards returns up the same side of the field—half the rake running on the peas as before and pulling up another lot, the other half raking over the strip previously pulled. With the straw dead ripe and fairly long a good job

is made, though there is always a certain amount of waste. With valuable peas the slower method of hand harvesting by skilful workers is probably the most satisfactory method.

After the peas have been pulled or cut two or three days they require turning. This is done with the ordinary hay fork. Turning is repeated every second day or so until both the grain and the straw of the peas is dry, when the crop is carted. If the weather is showery it is necessary to turn the peas very frequently, or the pods near the ground open and the grain is lost. In a wet harvest it is impossible to prevent a good deal of loss taking place owing to the peas shelling in this way. If, owing to prolonged wet weather the farmer is compelled to cut in spite of rain, it is desirable to make small bundles or wads, and to turn after every storm or day's rain, as soon as the wads are dry on the top. This keeps the wet pods from the soil as much as possible. The more the peas are turned the longer the pods remain sealed.

Stacking.—Peas are often placed in rather large stacks. There can be no doubt, however, that, in a wet harvest, they might be carted rather more quickly if the stacks were made narrower. The plan of placing faggots through the stack to act as a ventilation shaft is an excellent one.* Immediately the stack has been built, it should be temporarily covered with a stack cloth, or with "battens" or bundles of straw such as are used in the midlands. Thatching may be performed in a few days—as soon as the roof has settled a little. If a newly-built pea stack is left unprotected for even a single night, and heavy rain falls, great damage may ensue, as owing to the open nature of the peas practically all the rain falling on the roof will penetrate.

Thrashing.—Thrashing is performed in the same way as with cereals, but some slight alterations are necessary. A couple of hurdles are generally reared up over the feeding drum and covered with a stack sheet, forming a tent with one end left open. The concave of the machine is thrown back or made wider, thus avoiding the splitting of the peas. The feeding is generally done with a fork, and the sheet prevents the peas being scattered. If peas are very dry it is sometimes necessary to remove a beater or two from the drum, but as a rule the methods suggested above are sufficient.

* The Ministry in 1923 carried out some successful trials in the artificial drying of pea stacks. See *Artificial Drying of Crops* in this *Journal*, March, 1924, p. 1128.

Value of Straw.—Well harvested pea straw is very valuable fodder, and is much relished by all kinds of cattle, but for some reason it does not suit horses, causing discoloration of the urine, and is seldom, if ever, used for them. If much damaged by the weather pea straw may be almost worthless except for litter.

Mixing of Peas and Beans.—In some districts it is customary to grow a crop known as "blendings," *i.e.*, a mixture of peas and beans. A suitable mixture has an advantage over either crop alone in that it tends to keep weeds in check, as the beans hold the peas up, and make a smothering crop. One of the great disadvantages of peas grown alone, especially of short-strawed varieties of peas, is that they tend to encourage rubbish.

The mixture of peas and spring beans is also less liable to fail than either crop grown separately, whilst, if a suitable mixture is made, it, unlike peas alone, may be cut with the binder. On the other hand, owing to the dense nature of the crop, sun and air cannot gain access to the flowers so well, so that in some seasons the mixed crop may fail to produce so many or such large pods as is desirable.

For growing mixed with spring beans a fairly late variety of peas, such as either Maple or Black-eyed Susan, should be selected. A mixture found very successful at Saxmundham Experimental Station was 2 bushels of spring beans, and ¾ bushel of Maple peas per acre. This produced, as previously mentioned, an enormous bulk of straw, 62 cwt. per acre on one plot, and 40 bushels of corn. The crop was cut with the binder. It sometimes happens that winter beans are found in springtime to be thin; where this is the case they may be horse-hoed and an early variety of peas drilled in. The early peas usually ripen with the beans, and the whole makes a smother crop to keep down weeds.

* * * * * *

IMPROVEMENT OF GRASSLAND IN YORKSHIRE.

II.

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The Use of Phosphates.—There are in Yorkshire, as in most other counties, large areas of poor grassland which have had no previous preparation, such as that discussed in the May issue of this *Journal*, but which give remarkable improvements when adequate supplies of a suitable phosphatic manure are applied.

It is not difficult to recognise such areas of grassland. They occur chiefly on soils with comparatively low lime-requirements (small deficiencies of lime), such as the Boulder Clays of the North and East Ridings; the lighter glacial soils; the Limestone and Chalk soils; many of the alluvial soils, especially the heavy alluvium in the southern portion of the Vale of York and in Holderness; artificial and natural warp soils, occurring chiefly near the River Ouse and the Humber; the Boulder Clay soils in the northern Pennine district, where there is an abundance of limestone, and where the drift consists to a considerable extent of limy material, or where it covers thinly the limestone and the calcareous shales. Most of the sourer types of soil will also give a marked response to phosphates, provided they have at some time been limed sufficiently heavily.

Indications of the Need for Phosphates.—Some of the commonest indications to be found on land in suitable condition for phosphatic manuring are growths of hawthorn and wild rose, which, if neglected long enough give rise to strong bushes requiring considerable labour in stubbing or cutting when the improvement of such land is undertaken; sedges (commonly known as carnation grass) often occur in abundance; clover plants can be found, although they are badly developed, and the herbage generally is weedy, poor and thin; rest harrow is common on some land of this type; on lighter and drier soils, and especially on the tops of the ridges where the land is in ridge and furrow, the fescues often become the most important grasses; plantains are very noticeable, and land regularly mown is sometimes infested with yellow rattle. Tor grass often takes possession of pastures on drier situations where the land is limy, although it is by no means confined to light soils, and may often be quite common on heavy marls, especially those overlying limestone.

The conditions set out above are typical of phosphate-starved land, which will usually give a very marked response to phosphate properly applied. It does not often give any noticeable response to applications of lime; on the contrary liming frequently appears to reduce the amount of herbage already growing, and in such cases lime is often considered to do more harm than good. This effect of lime was noticeable on North Riding Boulder Clay at Brompton, Romanby and Thornborough. At other centres, *e.g.*, Howden (heavy alluvial soil), Bedale (light river alluvium) and Bramham Park (magnesium limestone soil), lime alone has had no noticeable effect on the herbage.

It has to be borne in mind when improving such soils that the first marked improvement consists chiefly in the development of the wild white clover, and as this plant objects almost as strongly to the presence of coarse rough herbage which constantly overshadows it, as it does to the deficiency of phosphate, it is frequently advisable to take steps to remove and keep down such coarse grasses as the tor grass when applying phosphate. It is also important to remember that the stubbing or cutting of the bushes, the burning off and severe harrowing of tor grass, rest harrow, etc., will not by itself usually effect a permanent improvement. Unless the soil conditions are improved at the same time the land quickly reverts to its former state, and it is generally a waste of labour to carry out such mechanical treatment without supporting it with adequate applications of phosphate.

An excellent demonstration of the effect of combining the mechanical and manurial treatment has been obtained on a series of plots in Bramham Park, where Plots 1 and 2 in the following series gave by far the best results:—

Plot 1.—Severely harrowed and 10 cwt. per acre of 38 per cent. basic slag applied.

Plot 2.— Do. do. do. with 2 lb. per acre of wild white clover seed sown.

Plot 3.—Untreated.

Plot 4.—10 cwt. per acre of 38 per cent. basic slag.

Plot 5.—2 tons per acre of magnesian limestone.

One portion of a series of plots at Brompton was very severely harrowed before the manures were applied. During the first year or two after treatment the clover runners were spreading along the cuts made in the rather matted turf. In the second and third years, however, the improvement, due to the application of basic slag, was so marked on both harrowed and unharrowed land that there is now no noticeable difference due to harrowing. The effect of the harrowing seems to be most important during the first and second years.

Phosphate Manures to Use.—At a number of centres, trials have been laid down with different types of phosphatic manures. At many of these centres the trials are not yet complete, and they will probably continue to give useful information for several years to come. Some important deductions may, however, be drawn from the results available.

All trials include, in addition to a plot which receives no phosphate at all, a standard plot receiving 10 cwt. per acre of a 38 per cent. Bessemer basic slag, so that in every case, on all

types of soil chosen, the phosphate manures are being tried against the old and well-known type of basic slag.

Ground Mineral Phosphate.—On the North Riding Boulder Clay at Romanby, on land which is not in ridge and furrow, the North African phosphate has given better results than at any other centre. During the first season and the beginning of the second after its application the mineral phosphate plot was distinctly behind that which received 38 per cent. basic slag. Towards the end of the second season there was no noticeable difference between the herbage on the mineral phosphate plot and that on the slag plot, and the two plots continue to show practically the same improvement.

At other North Riding centres where the fields are in ridge and furrow the improvement from North African phosphate is much more marked in the furrows than it is on the ridges. This applies also to some extent to the other phosphatic manures, but whereas the improvement from mineral phosphate is as good as that from 38 per cent. slag in the furrows it is not so good on the ridges.

Under drier soil conditions such as one finds on the ridges or on lighter drier soils ground mineral phosphate has given noticeably poorer results than 38 per cent. basic slag, and it has under such conditions usually been one of the least effective of the phosphatic manures tried.

An attempt has been made at a number of centres to increase the effectiveness of an application of the more insoluble phosphate manures by applying part of the phosphate as superphosphate, because, in dealing with cases of bad grassland, there are indications that it is important to give a big initial stimulus to the clovers. The following scheme was laid down at 9 centres in Yorkshire:—

	Quantities per acre.
Plot 1.—Basic slag 38 per cent.	10 cwt.
Plot 2.—Nauru phosphate 83 per cent. ...	4 cwt. 64 lb.
Plot 3.—Basic slag 16 per cent.	23 cwt. 84 lb.
Plot 4.—Nothing.	
Plot 5.—Superphosphate 30 per cent. ...	2 cwt.
Plot 6.—Basic slag 16 per cent.	20 cwt.
Superphosphate 30 per cent. ...	2 cwt.
Plot 7.—Nauru phosphate 83 per cent. ...	3 cwt. 96 lb.
Superphosphate 30 per cent. ...	2 cwt.

Plot 4 received no phosphate at all, and the other plots (except No. 5) received equivalent quantities of the various manures or mixtures, *i.e.*, equal quantities of phosphate of lime. Plot 5 was used simply as a control to Plots 6 and 7, which also received superphosphate in addition to some other phosphate.

This series was commenced in the spring of 1922. During the season 1923, especially early in the season the best plot at several centres was No. 3 (low grade slag). Later in the season considerable improvement was noticeable at most centres on Plots 1, 3 and 6, and it was often difficult to choose the best of those three plots. Of the other plots No. 7 was usually better than No. 2.

The effect of applying a portion of the phosphate as superphosphate, where phosphates of low citric solubility were employed, was sufficiently marked to encourage one to suggest that where grassland in ridge and furrow is to receive applications of phosphate manures of low citric solubility—such as ground mineral phosphate or insoluble slags (*e.g.*, Fluorspar slags)—the tops of the ridges might be greatly benefited by an additional small application of superphosphate. One drill width along the top of each ridge will usually embrace all the land under the driest conditions.

Basic Slags.—The response of grassland to low-grade basic slag (16 per cent. total phosphate of lime) has differed markedly, especially in the first season after its application. In several cases the 16 per cent. slag gave by far the best results in the first year. Unfortunately it was not ascertained at the time, and it is not now possible to ascertain, whether the slag used (which was not all from one consignment) had a high or low citric solubility. Stocks of low-grade slags, one of high and one of low citric solubility, have now been obtained, and these are included in series of plots laid down in 1923 and 1924.

The 38 per cent. slag is, of course, of high citric solubiilty, and one possible reason for the better result obtained from the 16 per cent. slag is the more uniform distribution of the phosphate which can be obtained with 23½ cwt. of 16 per cent. slag per acre than with 10 cwt. of high-grade slag per acre.

The possibility of some other constituent of the slag being responsible for this apparent superiority of low-grade slag has often been discussed, but there is up to the present no experimental evidence in support of it.

There is very little experimental evidence at present on the relative values of "low-grade low-soluble". and "low-grade high-soluble" basic slags on grassland. A number of experiments have been laid down recently in Yorkshire to test this point on a variety of soils, but the results will not be available until next season. On ploughed-out grassland under arable cultivation

and on light and fairly dry soils, the crop yields obtained from low-grade slags of low citric solubility have been very appreciably less than the yields from low-grade slags of high citric solubility. It would seem desirable to avoid the use of low-grade slags of low citric solubility on the lighter and drier soils. Such slags, however, appear to work well under the moister conditions which suit ground mineral phosphate. As it is not possible for the farmer to ascertain the citric solubility of his slags except by submitting a sample to an analytical chemist it is desirable that when he is trying to improve grassland on a light dry soil by applications of phosphate he should use only phosphate manures of high solubility. Whilst low-grade slags may or may not be of high citric solubility, slags of 30 per cent. (or over) total phosphate of lime are usually of high citric solubility.

On heavy soils or on lighter soils with a high water table, and consequently a good supply of moisture, any of the slags or finely-ground mineral phosphate will usually work well on grassland requiring phosphate, but the lighter and drier the soil the more soluble should be the phosphate used if the quickest and best returns are to be obtained. High-grade slags or highly soluble slags of lower grades are always safe and will generally give a good return where phosphate is needed. In addition to these, steamed bone flour or a mixture of superphosphate and steamed bone flour have given good results on light dry grassland, whilst superphosphate alone answers well on chalk or limestone land.

At Kipling Cotes, Market Weighton, on a chalk soil which has no "lime-requirement," the following scheme of plots was laid down in the winter 1922-23 on permanent grass-land:—

Plot 1.—Basic slag 38 per cent., 10 cwt. per acre.
Plot 2.—Unmanured
Plot 3.—Nauru phosphate 83 per cent., 4 cwt. 64 lb. per acre.
Plot 4.—Superphosphate, 4 cwt. per acre.

The plots are to remain down for six years, the superphosphate to be applied in three dressings at two-yearly intervals. At the end of 1923, Plot 1 was the best, closely followed by Plot 4.

Grassland placed in Class 3, and which shows an improvement either when lime alone or slag alone is applied, presents some of the most difficult cases on which to advise the farmer, not so much because it is difficult to say what the land requires (it needs both lime and phosphates as a rule) but because it is difficult to say what will be the most economical treatment.

Unfortunately, until this year, no grazing trials have been made on this type of grassland. The Royal Agricultural Society of England has now commenced a large-scale grazing trial near Clitheroe. This experiment, which is under the supervision of Professor Somerville, should give valuable information for the Boulder Clay on the Pennines.

Some points of interest as to methods of treatment which will give the best results have already been brought out by the Yorkshire plots. The eight series of plots which received originally lime alone and slag alone were cross-dressed two years later with 38 per cent. Bessemer slag at the rate of 10 cwt. per acre. This was applied to one-third of each plot so that in addition to plots receiving lime alone and slag alone there are now plots which have received slag after lime and slag after slag. In four cases out of the five where slag alone and lime alone have both given noticeable improvements the plot receiving slag after lime is now the best plot. The second application of slag to the original slag plot has in no case made an appreciable additional improvement, but this perhaps could scarcely be expected as it was applied only two years after the first full dose of 10 cwt. of 38 per cent. slag per acre.

It is apparently some years before the full effect of an application of lime alone is felt, as it does not during the first year or two give that tremendous stimulus to wild white clover so noticeable when slag is used; the improvement brought about by liming, however, appears to last much longer. It is only on land where the deficiency of lime is not serious that liberties, such as understocking for one or two seasons, can be taken with the grazing without serious deterioration of the herbage.

At Garforth (Field 39) on land limed in 1909-10-11 either by an application of compost (lime, soil, etc.) or of chalk a great improvement has been effected and maintained by periodical applications of basic slag (in 1913 or 1915, 1918 and 1921). A further application of lime applied to one plot in February, 1920, has given no additional improvement. A series of plots laid down on the same field in 1898, which have not been limed, are poor in comparison with the adjoining land, in spite of the fact that they were slagged in 1915, 1918 and 1921.

The improvement brought about by phosphates in these cases appears on detailed examination to be almost entirely due to an increase in the amount of wild white clover. Liming on the other hand appears to encourage the grasses, giving a thicker and taller herbage.

This was particularly noticeable on the plots at Silsden and Beamsley where the herbage on the " slag " and " control " plots appeared much dwarfer than that on the lime plots.

The fresher and greener appearance of the lime plots at these centres was largely due to the checking of woodrush, which originally formed one-quarter to one-third of the herbage. The flower heads of the woodrush which gave such a brown appearance in spring to the control and slag plots developed only to a small extent amongst the thicker herbage of the lime plots.

Most of the grassland of this type is patchy. Some patches contain plenty of clover and are well grazed; these respond well to suitable phosphates. Other patches grow a great deal of coarse, badly-grazed herbage on which the response to phosphates is often slow and uncertain. The most economical way of beginning the improvement of this intermediate type, especially on soils derived from glacial and alluvial deposits, is usually to begin with a suitable phosphatic manure and subsequently to lime those portions of land on which the response to phosphates is not satisfactory. On sour peats and on soils derived from coal-measures and non-calcareous grits and sandstones, on the other hand, it is usually desirable to begin with lime and to continue the improvement by applying phosphates.

Adequate Applications of Phosphate.—Many disappointments have been experienced through the use of inadequate applications of phosphate. The initial application in such cases should not be less than the equivalent of 10 cwt. per acre of a phosphatic manure containing 30 per cent. total phosphate of lime. It is usually more economical to apply the phosphate in any one year, at the above rate, to whatever acreage the available supply will cover, than to manure a larger area at a correspondingly lower rate of application. Where the land has been badly grazed every effort should be made by burning (if necessary) and harrowing to expose the soil on the rough patches immediately before applying either lime or phosphates. Whatever the material used it should be applied under fairly dry conditions. Either lime or slag if applied to grassland when wet on the surface is inclined to run together and set, a great deal of the advantage from having the material in a fine dry condition being thus lost.

Botanical analyses of the herbage on some of the types of grassland discussed are given in Table III. The centres where analyses were carried out are some of those arranged according to soils in Table I.*

* This *Journal*, May, 1924, p. 134.

Botanical analyses carried out in 1920 by Miss L. Scott, of the Department of Botany, University of Leeds, are to be found in the "Guide to Grassland Demonstrations in Yorkshire," obtainable from the Professor of Agriculture, The University, Leeds.

Use of Potash.—In order to ascertain whether a serious deficiency of potash was appreciably affecting the results obtained from an application of lime or phosphates on poor grassland, a cross-dressing of muriate of potash (1 cwt. per acre) was applied to one-third of each plot in the eight original lime-slag series. Some remarks on the results obtained will be found in the last column of Table I (this *Journal*, May, 1924, p. 134).

On the types of soil chosen, including light soils and a peaty soil, it appears that wherever the response to lime alone or slag alone has been unsatisfactory the addition of potash has not made any appreciable difference. The Yorkshire experiments on the point are admittedly incomplete as the trials have been made on a limited number of soil types only. Unsatisfactory results from applications of phosphate to grassland apparently due to a serious deficiency of potash have frequently been reported from other districts.

In some instances where lime or a phosphatic fertiliser effected a noticeable improvement in poor grazing land, the addition of potash produced a further improvement, but in all such cases the additional improvement due to potash was small in comparison with that due to lime or phosphate alone.

From the Yorkshire experiments it would seem desirable to make phosphates (and lime if necessary) the first charge on funds available for the improvement of poor grazing land, and to provide adequate applications of phosphate for the whole area to be improved before supplementing such treatment by the addition of potash. In the case of better grassland, or grassland on which phosphates have been used previously, the question of using potash should be considered. There are few reliable indications of potash starvation in permanent grassland; grassland on heavy soils as well as on light soils is sometimes in need of it. Further trials will be necessary. The evidence available is more definitely in favour of the use of potash for hay crops from temporary leys or permanent meadows, especially if no farmyard manure is used.

The Analyses in Table III were carried out in 1923 by Mr. R. E. Edwards, Department of Agriculture, University of Leeds. The centres are arranged according to the way in which the grassland responds to lime or to slag. The lime-requirements of the soils are given for comparison. The figures opposite the species of grasses or clover are percentages of the total area covered by each species.

TABLE III.

BOTANICAL ANALYSES OF HERBAGE (1923).

Centre.	Improved by liming. No apparent improvement from slag.				Improved by slag. No apparent improvement by liming.		Improved by lime alone and by slag alone.						
	Saddleworth*	Batley.	Sharlston.	Swine.	Thornborough.	Bramham† Park.	Nostell.	Parlington.	Silsden.	Beamsley*	Thornton-le-Beans.	Ainder by Steeple.	Dunswell.
Fescues	32	34	27	13**	17	23	23	42	21	16	43	18	3
Cocksfoot	—	7	1	—	3	3	7	—	—	—	—	—	8
Perennial Ryegrass	—	1	—	5	4	—	5	—	—	1	—	4	21
Other good grasses	1	13§	2	8	3	—	2	4	3	—	2	4	7
Bent Grass... ...	17	17	25	38	12	4	19	12	22	39	19	22	16
Yorkshire Fog ...	13‡	—	8‡	34	23	1	4	1	3	1	2	7	15
Other bad grasses ...	4	—	—	—	3	63††	6	1	10	4	—	5	1
Wild White Clover	1	—	—	—	10	1	12	13	1	1	4	3	23
Other Clovers ...	9	—	—	—	8	—	—	1	—	—	—	—	—
Woodrush	—	—	5	—	2	—	2	13	25	31	10	3	—
Sheep's Sorrel	—	1	4	—	1	—	—	—	1	—	1	—	—
Other Weeds ...	13	6	2	2	14	1	10	11	6	7	16	33	6
Number of species of plants noted ...	13	9	9	9	28	24	20	21	20	20	13	20	17
Lime requirements of soil	56	60	49	68	16	0	25	23	30	22	23	23	30

* Analyses by Miss Scott (1920).
† Analyses by Mr. T. Swarbrick.
‡ All *Holcus mollis*, no *H. lanatus*.
§ Chiefly Smooth-stalked Meadow Grass.
** Chiefly *Festuca myurus*.
†† Including Tor Grass (44 °/。) and Erect Brome Grass (15 %)

FEEDING EXPERIMENTS WITH SILAGE.

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THE erection in recent years of considerable numbers of tower silos, and the enthusiastic reports of the owners, indicate clearly that the making of silage must now be regarded as a thoroughly established practice on many farms in England, especially in the Midland and Eastern Counties. Accordingly, it is becoming more and more important that as much knowledge as possible should be accumulated concerning silage and its uses, and it is in the hope of the results having some value in practice that the following account of experiments with dairy cows is published.

The plan of the experiments follows that usually adopted:—Two groups of cows as evenly balanced as possible, a preliminary period for the animals to become accustomed to the rations, the first period of actual recording, a change over of the groups with another preliminary period, and then the second period of recording. The silage used in Experiment 1 was sainfoin, and in Experiment 2 oats, tares and beans.

Experiment 1.—Silage + Roots *v.* Roots Only.—Undoubtedly for a long time the most common set of conditions will be where the farmer is replacing part of his roots with silage. Few farmers will be so radical in their methods as to go in entirely for silage instead of roots. The question then is: "Having replaced part of my root break by silage, what is the best method of replacing part of the roots in the ration?" Chemical analysis suggests that advantage should be taken of the higher content of albuminoids in the silage, and the rations in Experiment 1 were drawn up with this object.

This experiment was carried out on the farm of Mr. Frank Harvey, of Hadham Hall, Bishop's Stortford, during the first quarter of 1924 We are greatly indebted to him and to his partner, Mr. Pocock, for the facilities provided, and for the enthusiasm and care with which the feeding and recording were carried out. Ten cows were selected from the herd of 35 heavy-milking Shorthorns and Friesians (the average of the herd is

920 gallons), but for convenience in feeding they were divided into two unequal groups of 6 and 4. As will be seen from Table I the selection was very satisfactorily carried out.

The Sainfoin Silage.—This was made from the first cut of the third year of the sainfoin ley, and was cut in June, 1923. The silo is of brick, and was constructed in 1918. The sample would be described as a very fine sample of acid silage, light green in colour, and with a most appetising smell.

Analysis.—

Water	75.4
Crude Protein	3.9
True Protein	2.8
Crude Oil	2.2
Soluble Carbohydrates ...	9.1
Fibre	7.7
Ash	1.7

The oil is rather higher and the albuminoids (protein) lower than might have been expected.

Estimated starch equivalent: Between 10 and 11 lb. per 100.

Rations used.—

	Ration 1. *lb.*	*Ration* 2. *lb.*
Roots...	70	30
Silage...	nil	40
Hay	8	8
Oat Straw	7	7
Linseed (boiled) ...	1	1
Beans	4	3
Oats	4	3

The basis of substitution was, therefore, 40 lb. silage = 40 lb. roots + 1 lb. beans + 1 lb. oats. These rations were for cows giving $2\frac{1}{2}$ gallons per day. In addition, for every gallon over $2\frac{1}{2}$ a mixture of equal parts of beans and oats was given at the rate of $3\frac{1}{4}$ lb.

The preliminary period started on 8th January, the first three weeks of experiment on 15th January; the week of change over was from 5th to 11th February, and the experiment terminated on 3rd March.

Results.—Throughout there was no difficulty in feeding either of the rations. and there was no appreciable difference of effect on the condition of the cows. Owing to the unequal size of the groups the total production of milk on the two rations cannot be taken as a measure, as it would not allow for the advance of lactation, but the following Table (No. I) and Diagram No. 1 show clearly that for practical purposes the two rations were identical :—

TABLE I.

	Root Ration. 8th Jan. to 4th Feb.		Silage + Root Ration. 5th Feb. to 3rd Mar.	
	Average yield per cow on 15th Jan.	Average yield per cow on 4th Feb.	Average yield per cow on 12th Feb.	Average yield per cow on 3rd Mar.
Group "A" (6 Cows) ...	30.8 lb.	29.1 lb.	29.3 lb.	27.2 lb.
	Silage + Root Ration. 8th Jan. to 4th Feb.		**Root Ration. 5th Feb. to 3rd Mar.**	
	Average yield per cow on 15th Jan.	Average yield per cow on 4th Feb.	Average yield per cow on 12th Feb.	Average yield per cow on 3rd Mar.
Group "B" (4 Cows) ...	30.8 lb.	28.9 lb.	29.3 lb.	27.3 lb.

At the commencement of the first period of experiment (15th Jan.) the average daily yield in both groups was exactly the same (30.8 lb.); at the end of the first period (4th Feb.) it differed by only 1/5 lb.; at the beginning of the second period of experiment (12th Feb.) it was again identical; and at the end, the difference was only 1/10 lb.

In Diagram No. 1 is plotted the average daily milk yield per cow taken over three-day periods. The milk of each cow was weighed at every milking, but to smooth out the minor fluctuations which invariably accompany daily yields, averages were determined from the total output of each group during successive three-day periods. It pictures clearly the normal falling off of yield in both cases as the period of lactation advances, and also shows the very small maximum difference between the two groups—a difference of only one-fifth of a gallon.

Cost of the Two Rations.—The difference in cost per cow per day in the two cases is the difference in cost between 40 lb. roots + 1 lb. beans + 1 lb. oats and 40 lb. silage. Mr. Harvey's costs of production were very carefully estimated, and it was concluded that the sainfoin silage and the roots were each produced at a cost of about £1 per ton.

	Pence.
40 lb. Roots at £1 per ton =	4.28
1 lb. Beans at £12 " " =	1.29
1 lb. Oats at £10 " " =	1.06
	6.63
40 lb. Silage at £1 " "	4.28
Difference ...	2.35d. daily per cow in favour of silage.

For a winter period of 180 days this difference amounts to £1 15s. 2d. per cow; or for a herd of 30 cows to £52 16s. Otherwise expressed it represents a difference of 0.8d. per gallon for an average daily yield of 3 gallons.

Conclusion.—Apart from any question of cost of production it is evident that the value of the silage was not over-estimated and that the basis of substitution was a reasonable one. We are of opinion that this method of utilising silage, viz., to replace some roots and some concentrates will often prove the most economical one in farming practice.

Experiment 2.—Silage *v.* Roots + Silage.—In this case the comparison was between one ration containing a normal amount of roots together with a moderate amount of silage, and the same ration in which the roots were replaced by approximately half their weight of silage, so that the second ration included what would be regarded as a large weight of silage. The results, therefore, apart from the comparison, are of interest in suggesting a suitable ration where roots have been entirely replaced by silage crops or where, for other reasons, they are not available.

Through the kindness of A. S. Bowlby, Esq., Gilston Park, Harlow, the experiment was carried out with 12 cows selected from the Overhall herd of 70 Friesians, under the supervision of Captain S. E. Buckley. Here also we should like to express our keen appreciation of the interest shown, and the great care with which the feeding and recording were done.

Particulars of the Silage.—The seeding was 2 bushels tares, 1 bush. beans, 1 bush. oats, ½ bush. wheat: and cutting took place towards the end of June and in early July. The silo was Gascoigne's "Economic" Steel type. This was a nice sample of acid silage, light green in colour and appetising in smell.

Analysis.—

Water	77.3	
Crude Protein	3.5	
Pure Protein	2.2	
Crude Oil	1.7	
Soluble Carbohydrates ...	7.8	Estimated Starch Equivalent
Fibre	7.5	10 lb. per 100.
Ash	2.2	

Rations.—

	Ration 1. *lb.*	*Ration* 2. *lb.*
Roots	56	nil
Silage	23½	50
Hay	14	14
Oat Chaff	4	(4)

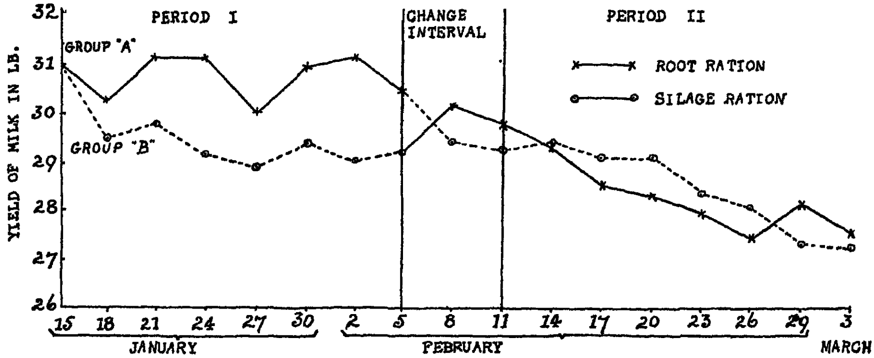

FIG. 1.—Average Daily Yield over 3-day periods.

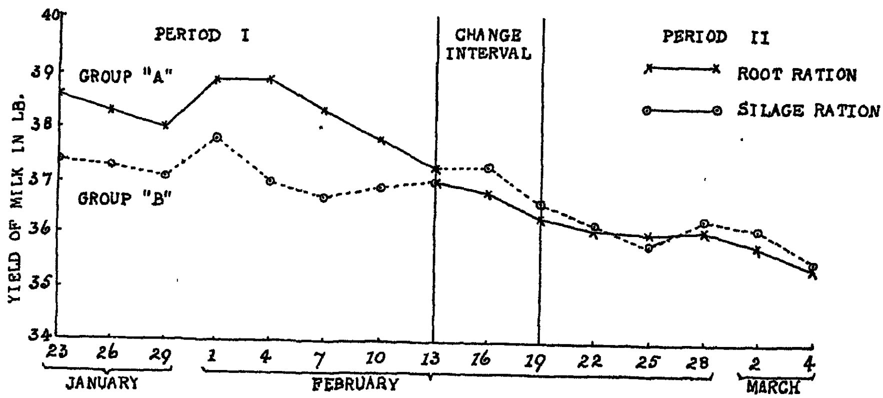

FIG. 2.—Average Daily Yield over 3-day periods.

Here the substitution is 26½ silage = 56 roots, or approximately 1 of silage for 2 of roots. In addition for every gallon above one, 3½ lb. of the following mixture :—beans 2 lb., oats 2 lb., dried grains 2 lb., wheat or barley 2 lb., ground nut cake 1½ lb., fish meal ½ lb.

During the first few days of the preliminary period it was thought doubtful whether the cows would consume 50 lb. of silage. The oat chaff was, therefore, omitted from the ration and more time given to the cows for watering. By the end of the preliminary period the cows were clearing up their 50 lb. of silage, but during the experimental period the oat chaff was not again included in this ration. The supply of water is without doubt an important point when feeding large quantities of silage.

Results.—The results are presented in the same form as those of Experiment 1.

Preliminary Period	16th—22nd January.
First Experimental Period ...	23rd January—12th February (3 weeks).
Period of Change	13th—19th February.
Final Experimental Period ...	20th February—4th March (2 „).

TABLE II.

	Root Ration. 16th Jan. to 12th Feb.		Silage Ration. 13th Feb. to 4th Mar.	
	Average yield per cow 23rd Jan.	Average yield per cow 12th Feb.	Average yield per cow 20th Feb.	Average yield per cow 4th Mar.
Group "A" (6 Cows) ...	38.6 lb.	37.7 lb.	36.4 lb.	35.5 lb.
	Silage Ration. 16th Jan. to 12th Feb.		**Root Ration. 13th Feb. to 4th Mar.**	
	Average yield per cow 23rd Jan.	Average yield per cow 12th Feb.	Average yield per cow 20th Feb.	Average yield per cow 4th Mar.
Group "B" (6 Cows) ...	37.4 lb.	36.8 lb.	36.0 lb.	35.4 lb.

Here, again, Table II and Diagram 2 show clearly that there was nothing to choose between the two rations. This is particularly well shown during the interval of changing over; the slow rate of fall continues unaltered as though the cows were quite unaffected by the change from roots to silage and *vice versa*.

Comparison of Cost.—Since the oat straw chaff was removed from the silage ration 26½ lb. silage replaced 56 lb. roots + 4 lb. chaff.

The actual costs of production were:—silage, £1 7s. 1½d. per ton; roots, £1 0s. 4d. per ton; oat straw chaff was valued at 45s. per ton.

		Pence.
56 lb. Roots ...	at £1 0s. 4d. per ton =	6.1
4 lb. Oat Straw Chaff	at £2 5s. 0d. „ „ =	.96
	Total	7.06
26½ lb. Silage ...	at £1 7s. 1½d. per ton =	3.85
	Difference ...	3.21d.

As before, the silage ration is distinctly cheaper than that including roots: For a herd of 30 cows over a period of six months the difference in favour of the silage ration without roots would amount to £72 4s. 6d. For a 3-gallon average the difference is just over 1d. per gallon.

* * * * * *

A FRENCH BROCCOLI PACKING STATION.

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THE fickle climate of England during the winter months often gives great anxiety to growers who are bold enough to attempt the growing of green vegetables for market purposes during the months of January, February and March. The prevailing temperature during this period is usually so low that plant-growth is extremely slow, whilst at times frosts are so severe as to injure all succulent and young growth. In the presence of such obstacles production on a general scale is only attempted in a few areas specially situated and protected from winter's frosts, or so situated as to benefit from the heating effect of the warm gulf stream. One such district is the Penzance area of Cornwall, where the White Broccoli grows and develops large and fine white heads during the winter, whilst the growth of similar varieties in other districts is usually imperceptible. Though this is perhaps the only important home area, its products do not enjoy the monopoly of the market, but have to compete with similar products from France (Brittany) and from Italy (Milan).

With regard to the supply from Brittany, figures supplied by the Southern Railway show that during the months of December, 1923, and January, 1924, the boats from St. Malo to Southampton brought 4,581 tons of "Choux-fleurs," including

both cauliflowers and broccoli. This figure indicates that the French industry is flourishing and that its products presumably find a ready market in this country. The subject merits closer consideration and analysis, for it may be that some feature of the French industry may be of interest and use to home-growers in helping them to compete in the home markets.

The Southern Railway boats load for England at the French port of St. Malo, and no doubt some of the "choux-fleurs" are produced by the farmers in that area; but it is known that the majority—which are of the broccoli type—have been grown further west, in the district extending north-east and west of the small town of Saint Pol-de-Léon, in Finistère, Brittany.

The soil is not very different from that found at Penzance, while the methods of manuring are somewhat similar, in that sea-weed is largely used to supply humus to a poor soil, which is further enriched in plant-food by the plentiful use of mixed fertilisers. Forty or fifty cart-loads of sea-weed to the acre and 8 or 9 cwt. of artificials form quite a common dressing. This seems somewhat lavish manuring, but, as will be seen later, the crops grown are gross feeders. The weather is mild but not free from frost, and the district is said to experience less rain than the Penzance area, but the lichens and mossy-coated fruit trees indicate that there is no shortage of atmospheric moisture. The broccoli are produced on small farms of from 3 acres to not more than 8 acres, with perhaps 5 acres as an average. Some of the peasants have taken advantage of a Government system of agricultural credits and borrowed State money at 2 per cent. to purchase their holdings; others simply rent the farms from landed proprietors just as do many farmers in this country. The Breton peasant farmer, having little but his farm to interest him, spends most of his time, from dawn to dusk, cultivating, manuring and weeding his land, as the case may be. His wife and children assist him, and each family is usually sufficient to care for its holding. The practice of hiring labour is almost unknown.

These "peasant farms" are general through France, but the St. Pol-de-Léon industry is exceptional in that it is specialised for the production of selected vegetable crops, of which the artichoke, broccoli, early potato and onion are the most important.

The artichoke is grown for the French markets, though doubtless supplies would be sent to England were the English people to develop a taste for it.

Broccoli, grown formerly for the French market, has achieved such success that more than half of the total crop is exported annually to England, Holland, Germany and Switzerland. The onions have been made well known in England by the Breton peasant growers, who, dressed in their quaint costumes, yearly tour England selling their strings of onions, and, at the same time, acquiring a knowledge of the English language. For the potato industry the growers cultivate two kinds in some quantities; a yellow-fleshed early variety for the French markets and the old Up-to-Date for export to England.

Methods of Cultivation.—At the time of the writer's visit (February) the peasants were busy marketing the broccoli crop, and one was able to visit the fields and markets and obtain a glimpse into their industry. The broccoli industry dates back for one hundred years or more, during which time it is said the peasants have made no great alterations in the variety grown, beyond annually improving the strain by saving for seed production the largest and most shapely plants to be found in the crop. This practice of seed saving is general. A peasant is reluctant to buy seed, and obstinately refuses to sell seed lest some of his competitors secure his particular strain. The land is well cultivated, richly manured, and kept scrupulously free from weeds, and the plants are given ample room for development, being planted on the square with a distance of one metre (39¼ in.) between each plant.

Under these conditions good crops are obtained, though naturally much variation in size and maturity is present in all fields. St. Pol-de-Léon, like Penzance, is far distant from the market centres and, but for the existence of a good system of marketing, heavy expenses would eat too deeply into the market returns and growers would secure but a fraction of the full market price. It was of special interest, therefore, to study the marketing methods adopted, for it was known that the French package of broccoli had won its way to popularity amongst retailers on the English markets.

The peasants bring their broccoli in carts to the town of St. Pol-de-Léon, where in the market square sales take place daily. When the writer visited the town early on the morning of 13th February, there were 100 or more growers, each with his cart containing from 200 to 300 untrimmed heads of broccoli of varying sizes, making their deals at a price per cart-load with the wholesale merchants. When completed the peasant delivered his load into the packing sheds of the merchants, drew his money in bank notes, and departed.

The merchants' establishment consists of a long open shed where the packing is done, a house and an office. The staff consists of clerks and a number of men and boys skilled in grading, trimming and preparing the crop for market. The merchant's business consists solely in handling and marketing the produce grown locally, and from his skill in doing this he derives his profit.

There was a great similarity between the operations at each packing station. The broccoli from the carts were sorted into heaps of heads of similar size, and these are known as (*a*) giant, (*b*) large, (*c*) English, and (*d*) small. An average cart-load of well-grown broccoli would grade into 10 per cent. of (*a*), 40 per cent. of (*b*), 40 per cent. of (*c*), and 10 per cent. of (*d*). The produce of each grade was kept separate. After grading, the heads were trimmed to remove surplus leaves and portions of stem so that transport expenditure is incurred only on the essential portions. Each trimmer used a very large knife with a blade fully 1 ft. long and 4 in. wide, to cut off all the useless portions of the stem from the base end, and such parts of the leaves as extend beyond the flower head. Some leaves were removed entirely. The waste leaves and stems were reloaded into the peasants' carts, and removed for cattle feeding.

The trimmed heads were collected by boys and carefully packed into crates of a standard size. These crates contained 12 giants, 18 large or 24 English, as the case might be. Special notice was taken of the packing of Grade (*c*), for that sample is usually sent to English markets. The 24 heads of broccoli were arranged in three layers, each of which consisted of a double row of 4, arranged so that the stems all pointed outwards and the heads lay in the middle.

A well-packed crate has the appearance of being a little too full, and when the top is closed with the thin wooden bars, a perceptible outward bulge occurs. These bulging bars constitute a spring which holds the broccoli heads secure and steady during transport.

The crates carry trade-marks of the several packing houses and the letter A, B, C or D, as a distinguishing grade-mark. They are packed into railway vans, each of which contains about 5 tons, and are despatched by rail to France and Germany, and to St. Malo for England.

A Co-operative Packing Station.—One of the packing stations visited, known as "La Bretonne," is run co-operatively by a group of farmers. In size and business turnover

this station ranks third in the district. The peasant farmers supporting the society deliver their loads of broccoli direct to the station. and so save the process of selling in the market of St. Pol-de-Léon. The loads of broccoli are sorted into the several grades, and the numbers of broccoli of each grade are entered into the society's books; and on this entry the share of the market returns of each grower is calculated. From this stage onwards the identity of each individual grower's produce is lost, for it is trimmed, packed and marketed as before mentioned.

At present the co-operative society is in a strong position. It has a large turnover and is effecting good sales. The manager—Monsieur Berest—stated that the growers were getting about 8 per cent. more for their produce by marketing through their own packing station than by selling to the merchants. The present successful position of the society has been reached after years of toil and disappointment, as the following notes indicate.

The society was started in 1910, with a capital of 20,000 gold francs, and a membership of 100 growers. The early efforts proved unsuccessful—money was lost and members dropped out—and to prevent the society from becoming defunct the French Ministry of Agriculture in 1912 advanced a loan of 50,000 gold francs at 2 per cent., for the repayment of which all the members had accepted a personal pledge and responsibility. Experience had been gained and more prosperous times were ahead, and by 1920 the society gained such a strong position that it was able to repay the Government loan and carry on the whole business without difficulty. Further progress has been made with each succeeding year, and now the society has a turnover exceeding 2,000,000 francs.

The operations of this packing station are not limited to the trimming, grading, packing and selling of the broccoli crop, but it handles in a similar manner most of the vegetable crops of its farmer members. The society, for instance, marketed in 1923, artichokes to the value of 600,000 francs, potatoes 450,000 francs, broccoli 400,000 francs, and miscellaneous crops (such as onions, garlic, etc.) 150,000 francs. The society also purchases manures in bulk, makes its own mixtures for sale to its members, distributing during last year over 300,000 francs worth of manure.

This story of the successful working of a farmers' packing station on co-operative lines should be of considerable interest and use to home-growers at the present time, now that British

markets have become particular that produce shall be specially graded and packed. To understand this is simple; to effect a proper marketing system in practice is more difficult, because each individual grower finds he has no skilled and expert grader and packer or that, when graded, the number of packages of each grade is too small to effect good sales. Each has been brought up in the belief of individual enterprise, yet the experience of the French packing stations demonstrates that by a combination of growers it is possible, by setting up packing stations and marketing societies, to handle large blocks of similar kinds of produce, and to achieve a great success in both home and foreign markets.

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THE CULTIVATION OF CHERRIES.

I

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CULTIVATED cherries fall roughly into two main groups, usually referred to as "sweet" and "sour" cherries, which differ from each other in many respects. The former comprise the Gean and Bigarreau, classed as dessert cherries, and the latter, the Flemish, Kentish and Morello varieties, classed as cooking cherries. The sweet cherries appear to have been derived from the wild Gean (*Prunus avium*) and the sour cherries from the common wild cherry (*Prunus cerasus*). Both these natural species are believed to be indigenous to this country.

I.—**SWEET CHERRIES.**—By far the greater proportion of sweet cherry trees are grown as standards in grass orchards, and there is no doubt whatever that this method of culture is the most suitable. It is true that they may be, and actually are, grown on cultivated land, but the attendant difficulties are many and, unless there are reasons against it, all cherry orchards should be grassed down after the tenth or twelfth year. On grass the trees do not tend to make rank growth and can be kept in a better fruiting condition. There is also less inclination to "gumming," so marked where trees are on cultivated land. Another and even more important reason in favour of grass is the fact that cherries are largely surface rooting and are adversely affected by root disturbance.

Soil and Situation.—Cherries prefer light, well-drained soils, and undoubtedly such soils as so-called "brick-earth" and

light medium loams are the best when there is good under-drainage. The trees succeed well on the true chalk formations when there is a good top depth of loam. They do not thrive on cold heavy clay, such as Wealden clay or on badly drained soil of any kind.

Situation is very important, and the various aspects of the land to be planted should be carefully considered. Cherries blossom very early in the season, hence the necessity for choosing an open situation. One where the sun will come gradually on to the blossoming trees will mitigate the risk of damage from frost scald. Deep valleys and sites where the configuration of the land tends to form frost pockets should be avoided.

Blank, wind-swept situations open to the south-west are undesirable unless a wind-break of poplar or other quick-growing timber can be planted. Access is required to a water supply both for tree-washing and for the grazing stock.

Propagation.—Sweet cherries for orchard growth are usually worked on the Gean or Gaskin stock (*P. avium*). The stocks are grown from seed by Continental nurserymen and imported into this country. The stocks are generally top grafted, working at 6 ft. high if standard trees are required. Some growers prefer to plant the stocks in their permanent tree position and to delay grafting until the stocks have become established. This is only possible where a supply of Geans can be obtained in the local woods, but there is a decided balance in favour of raising the trees in a nursery or purchasing them ready for planting from a reputable nurseryman. Standard trees for planting out should be the usual trained standards 3 to 4 years old and from 5 ft. to 6 ft. in height. They should not in any case be less than 5 ft. 3 in. in height.

The Mahaleb as a stock for cherries for thought to have advantages over the Gean, where less vigorous growth was desired, but recent investigations have shown that this stock is just as vigorous as the Gean and it is not much employed.

Planting.—There are at least three methods which may be employed in establishing a cherry orchard. The first, and perhaps that most frequently adopted, is to inter-plant the cherries with fillers of apples and plums, or both, and with bush fruit occupying the ground beneath. This mixed fruit plantation is then managed, and the land cultivated, in the usual way for upwards of ten years, when the bush fruit is taken out and the land grassed down. As the cherry trees develop, the apples and plums are also removed to give room. This method

is the most economical, and can be recommended, as the plantation receives proper cultivation and constant manuring, and the cherries secure a good start and produce strong well-balanced trees.

The trees may also be planted direct on existing grass land, but growth is much slower.

A third plan is to plant the trees amongst hops, but experience has shown that this is the least satisfactory method, for when the hops are grubbed and the land grassed down the quickly-grown and succulent cherry trees experience a severe check.

The correct spacing of the trees by either method is all-important, for cherry trees grow to a considerable size and last in a profitable condition for over 60 years, and it is important that when fully grown the trees shall not become overcrowded. The tree cannot be restricted by cutting, for cherries will not tolerate such treatment. Economy of space may be obtained and more trees planted to the acre by planting the less vigorous and more upright-growing varieties alternately with the strong-growing, spreading sorts.

As a rule most varieties on standards should be spaced from 30 ft. to 40 ft. apart each way, but never closer than 30 ft. A satisfactory distance, when trees are judiciously arranged as described above, has been found to be 32 ft., giving 50 trees to the acre.

The actual cultivation of the land, as well as the general planting procedure, which is the same for cherries as for all other fruit trees, is fully described in the Ministry's Leaflet No. 148 (*Planning and Planting a Fruit Plantation*) and will not, therefore, be described in detail here. The following salient points, however, are worthy of special mention:—

1. The equilateral triangle system is, on the whole, the most suitable one for cherry trees grown as standards.
2. Good large holes, 3 ft. square and 2 ft. deep, should be dug, and the trees must not be planted too deeply; the nearer to the surface the better. The soil must be well trodden in.
3. The trees should be staked at once, employing for preference two stout creosoted stakes, with a cross piece to which the tree should be securely tied with proper protection against chafing.

Choice of Varieties.—The choice of varieties also requires careful consideration. Although the information available is by no means complete, research has shown that certain varieties are positively self-sterile and that cross-pollination is an important factor in cherry growing.

Self-sterile Varieties	*Freely pollinated by*
Early Rivers	Turkey Heart or Black Circassian.
Waterloo	Amber Heart.
Grosvenor Wood	Amber Heart.

There is no doubt that the planting of blocks of one particular variety is an unwise practice and has been the cause of crop failure in orchards.

There are many advantages to be gained by choosing varieties which will ripen in succession. In this way the picking can be spread over a longer period, and the market be more regularly supplied.

A list of varieties of proved merit is given below, with notes as to class, season of ripening, etc. As far as possible the name employed in each case is the authentic one, but a good deal of confusion exists as to the nomenclature of cherries, especially amongst growers in different localities. To avoid confusion and disappointment, trees should be purchased from reliable raisers who employ the names indicated and who preserve their stocks free from mixture.

Pruning.—Sweet cherries are spur bearers and fruit without encouragement from the pruning knife. After the tree is once shaped, which will be in three or four years after planting, the trees will thrive best if not pruned at all. If the branches become too crowded in after life the trees should be thinned, and thinning is best done while the trees are in leaf in September, as at that time they are not so prone to "gumming." If the branches sweep down so as to come within reach of live stock they must of course be shortened back.

A certain amount of dead wood will be produced by fully-grown trees, and orchards must be gone over once a year in the autumn or winter for the purpose of removing this. All cuts made on cherry trees should be covered immediately with paint or tar to prevent the entrance of fungus spores.

Management of the Orchard.—In laying down an orchard to grass special care must be taken to obtain a fine turf. A good mixture of the finer grasses only should be sown; the coarser species such as cocksfoot, rye-grasses and oat grasses are best excluded. Clover should not be sown, as the only desirable clover, the wild white, will probably develop of its own accord if the orchard is properly managed.

The orchards are best sown down in the autumn, during August or September, after the last fruit crop has been taken from the bush fruit, if such has been planted beneath the trees.

The land must be carefully cleaned of all perennial weeds such as thistles, docks, nettles and couch grass, and should be made firm before sowing.

Grass orchards should be grazed closely with sheep. In practice grass cherry orchards are usually employed for fattening sheep, numbers of tegs being fed on mangolds, cake and the grass and sold off as they become ready for market. As a rule 10 sheep are run to the acre. If the profit from the sheep is small it must be borne in mind that their main value in the orchard lies in the manure they supply to the trees and the service they render in keeping the grass short. On no account should cherry orchards be allowed to grow crops of hay, as the trees suffer greatly from this practice.

In addition to the organic manure supplied by the sheep the trees demand a supply of phosphate and potash. The application of artificials is a question which must be tackled experimentally until the best results are obtained. Basic slag applied in the autumn is a valuable dressing on some soils, as a source of lime and phosphates, and will also tend to encourage the growth of white clover. Many growers find that a dressing of 2 to 3 cwt. of superphosphate and 1½ cwt. of muriate of potash per acre, applied in the spring, gives satisfactory results.

The application of lime or chalk is also necessary for cherries in common with all stone fruits. Lime may be applied in the form of quick-lime but "ground lime" is preferable. From 15 to 20 cwt. per acre once every three years, or from 5 to 10 cwt., if basic slag is being given, would be a fair dressing. Chalk may be applied in the form of ground chalk and a fair dressing would be 25 to 30 cwt. per acre.

Neglect to feed cherry trees adequately and regularly is a great mistake, for it will be found that the orchard will well repay the necessary expenditure.

The turf should be maintained in good condition by an annual chain harrowing and rolling in the early spring to break down mole and worm casts and to clear off the moss.

An ideal cherry orchard will possess a turf almost like that of a lawn, but kept short entirely by sheep. The latter should be kept off during the winter months, approximately from the middle of November to the middle of February.

Gathering and Marketing the Fruit.—Birds are a trouble to the cherry grower. As the fruit ripens, more and more are attracted. It will be necessary, especially in the case of isolated orchards, to provide a bird scarer from daylight to dark. If the

bird-scarer is provided with a gun he should be warned against firing charges of shot into the trees. Various scaring devices can also be rigged up in the trees themselves.

The worst bird enemies are blackbirds, thrushes, jays and starlings, the latter invading the orchards in flocks and doing a vast amount of damage if left undisturbed. Sparrows also peck off the opening buds and blossoms in the spring, and bullfinches may do a good deal of damage to the buds in the winter. As it costs almost as much to keep the birds off 5 acres as 50, small orchards are not recommended.

The gathering of fruit can be done by women working in gangs with a man to move the ladders and pack the cherries for market. Each tree is picked over once or twice before being finally cleared. Cherries should not be picked when wet, since they will not then travel well. During wet seasons the fruit is liable to crack and rot; extra care is then required to ensure presentable fruit being sent to market.

By far the greater bulk of the sweet cherry crop is marketed in half-sieves holding 24 lb. of fruit. The sieves are lined with paper and the covering paper usually bears the grower's name and address or special mark. In years of scarcity, and in the case of fruit of exceptional quality, pecks holding 12 lb. are used. Picking and despatch of the fruit are done on the same day.

Experience has demonstrated that it pays to grade the fruit into two classes. First grade cherries have been known to realise several shillings more per sieve than the second grade and, moreover, the average price for the whole of the crop will be higher than in the case where no grading is done.

In recognised cherry-growing districts it is often the practice to sell the crop on the tree either at cherry auctions or by private treaty; and, as a rule, in such cases the grower's responsibility ceases with the sale, the purchaser picking and marketing the fruit himself.

There is a market for the finest Bigarreaus for the manufacture of glacé cherries, in which case they are consigned straight to the factory.

Market Varieties of Sweet Cherries.—The cherries described below are named as nearly as possible in order of ripening.

EARLY RIVERS.—(Middle to end of June). *Fruit* fairly large, heart-shaped, shining black when fully ripe, with a small stone. Flesh rather tender, juicy, and flavour fairly rich and sweet. Travels fairly well. *Tree* is a strong grower with open spreading habit. The branches have

a distinctly drooping effect. A good orchard variety which crops regularly and well. Self-sterile.

GOVERNOR WOOD.—(End of June and early July). *Fruit* large, heart-shaped, pale yellow, flushed with light red. Flesh tender, juicy and very sweet. Stone small. *Tree* is a strong free grower; habit upright to spreading and crops well. Self-sterile.

This variety, which came from America, has established itself as a good market cherry. The fruit is rather on the soft side and is inclined to crack and rot in wet seasons. It travels only fairly well and requires careful handling.

KNIGHT'S EARLY BLACK.—(Early July). Usually follows Early Rivers very closely. *Fruit* large, obtuse heart-shaped with irregular surface. Dark purple, black, or dead black when fully ripe. Flesh purplish red with a sweet rich flavour. Texture fairly firm and travels fairly well. *Tree* is a free grower. This is one of the best black cherries, although a medium cropper.

This variety is sometimes referred to locally as Circassian. It is quite distinct, however, from Black Circassian, correctly known as Black Tartarian.

BLACK TARTARIAN (OR CIRCASSIAN).—(End of June). *Fruit* very large, shining purple black or quite black. Flesh purplish, rather tender, fine full flavour, stone small. *Tree* of upright, bushy habit, spreading more as it ages, and carrying a wealth of foliage. A first-class cherry and a good, regular cropper.

ELTON.—(Early July). *Fruit* large, heart-shaped, pale yellow, mottled with bright red. Flesh pale, tender, sweet and flavour fair. Stone medium. Does not travel too well. *Tree* a free grower of spreading pendulous habit. Rather a shy bearer and the fruit is inclined to crack in wet seasons. This cherry is losing favour as a market variety but does exceptionally well in some localities.

FROGMORE BIGARREAU.—(Early July). The earliest of the Bigarreau Class and a little later than Governor Wood. *Fruit* large, obtuse heart-shaped, rather flattened on the side, pale yellow, flushed with red. Flesh tender, very sweet and of good flavour. It is firmer than Governor Wood but not quite so large and a better cherry in a wet season. Travels well. *Tree* a free grower, upright to spreading, a good cropper, self-sterile.

BLACK HEART.—(Early to Middle July). *Fruit* fairly large, heart-shaped, uneven, dark blackish-purple. Flesh dark red, firm and sweet. Flavour fair. Stone large. *Tree* makes medium spreading growth; is a regular, free cropper. A very old cherry, doing well in grass orchards and sells well for cooking purposes.

WATERLOO.—(Early July). *Fruit* large, heart-shaped, deep shining black, uneven. Flesh fairly firm, sweet, flavour rich, stone small. *Tree* is a free grower of compact upright habit, a little shy in bearing but fairly regular. Self-sterile. A very old variety but a good market cherry, hanging well after ripening and good for wet seasons.

BLACK EAGLE.—(Middle to late July). *Fruit* large, heart-shaped, deep purplish black, full, rich, sweet flavour. Stone small. The fruit and habit of tree closely resembles Waterloo but it is a little later. Rather inclined to run off in stoning.

A local variety known as Malling Black Eagle is distinct from this cherry and is not recommended for general cultivation.

Amber Heart (or Kentish Bigarreau).—(End of July). *Fruit* medium size; even, pale yellow, mottled with dull red. Flesh white, juicy and sweet. Quality good, stone medium. *Tree* grows well with upright, open habit and is a prolific cropper. This variety is very old and is a very profitable one in Kent.

Napoleon Bigarreau.—(Early August). *Fruit* very large, heart-shaped, flattened on one side, pale yellow, splashed with bright red. Flesh firm, juicy, full rich flavour. Travels well. *Tree* very vigorous, hardy, of spreading habit, a prolific cropper and self-sterile. Rather susceptible to silver leaf disease. This is a fine market cherry, one of the best of this class, and soon makes a tree.

Turkey Heart (or The Turk).—(Middle August). *Fruit* medium, heart-shaped, black. Flesh firm and very full flavoured. Travels well. Stone small. *Tree* fairly free growth, upright to slightly spreading habit

An old variety very popular in Kent. It is one of the first to blossom and therefore liable to frost damage. Fruit ripens up rather unevenly.

Emperor Francis.—(August). *Fruit* very large, dark red, flesh firm, sweet and rich flavoured. Travels well. Stone small. *Tree* of medium, upright habit. One of the best late cherries and does well in the North.

Tradescant Heart (or Noble).—(Early August). *Fruit* very large, heart-shaped, uneven, dark red to blackish purple. Flesh, dark purple, firm, slightly acid, rich flavour. Inclined to crack in wet seasons. *Tree* of medium growth, upright habit. This cherry is of recent introduction to Kentish orchards, where it is known as Noble. It is an old variety.

Florence.—(Middle August). *Fruit* very large, heart-shaped, pale yellow flushed with red, shining. Flesh very firm, sweet and of first-rate flavour. Travels well. *Tree* a moderate grower, of rather spreading habit. One of the best late cherries and deserves to be grown more for market.

There are other varieties, less known, which possess valuable qualities for commercial orchards, and are also well worth growing.

(To be concluded.)

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NOTES ON POULTRY KEEPING.

C. A. Flatt,

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Generally speaking there is a healthy optimism amongst poultry keepers, in spite of the very trying and to some extent disappointing hatching season. At the time of writing (mid-May) the rise in egg prices is encouraging, though slight, and the demand for spring chickens, always ahead of the supply at this season, offers the fortunate possessors of January hatches the opportunity to realise a good profit on their cockerels—so good in fact that there are visions of a shortage of these very early stock birds next autumn.

Hens also are making good prices, and many of the 1923 pullets which have failed to produce eggs of the 2 oz. standard during the spring cycle will leave the yards of reputable breeders for the table.

Incubation.—By the time these notes appear incubators will have been set aside, and a thorough cleansing and disinfection of these should already have taken place.

Writing recently in the "Feathered World," Mr. Edward Brown directed attention to the growth of the "baby chick" hatcheries in the United States, and one may ask how soon the suggestion of the value of similar institutions in this country will take effect. How much of the poultry keeper's capital is tied up in incubators and in buildings in which these are installed? It is true that in a large number of instances, where hatching operations are upon a small scale, no special buildings are set aside. (Incidentally many of these makeshift places are responsible for bad hatching.) There must in any case be a large sum of money earning no dividend for 6 or 8 months of the year, and the small holder poultry keeper can ill afford to have capital lying idle.

Mammoth incubators have already effected great economies in labour, but this is nothing to what might be accomplished with their more extended use. Hatcheries might also lead to recognised breeding centres, which would again be an economy. On the other hand, although poultry keepers sometimes complain of the labour and tie of hatching, to the majority of them this is a particularly attractive part of their work, even to those who bring no special interest to bear upon the problems which face them in artificial incubation. Sentiment possibly enters more largely into the make-up of the English poultry keeper than of his American or Canadian equivalent. Commercially the proposition has a great deal to recommend it.

Housing.—Among the various directions in which great improvement in poultry culture has recently been effected the housing of poultry has taken a prominent part. It is probable that more capital has been put into poultry farming in the past five years than in double that time before. Earlier experiences dissipated the idea that a successful business and a good income awaited the man ready to invest a small capital in poultry farming, and success with a few hundred pounds proved the exception rather than the rule.

The tendency in recent years has in consequence to some extent been reversed, and in a large number of cases the housing

of poultry has been on an extravagant scale. With large flocks, considerable economy can be effected, but large houses are to some extent permanent and it is essential to cut down the cost to a minimum compatible with efficiency, in order to avoid heavy overhead charges on the poultry stock.

With an allowance of only 10s. per head for the housing of the laying hens the annual charge, at the rate of 15 per cent. to cover interest and depreciation—the usual allowance—is sufficiently heavy for the profitable production of eggs for consumption. At this cost it is not a simple matter to attain the ideal and to give effect to all the labour-saving contrivances in accordance with modern ideas.

Extravagance is even more apparent in the buildings erected for chicken rearing. Large brooder houses expensively fitted at a cost of several hundred pounds will take many good seasons to justify their cost. Many such, like the incubators, will only contribute to the dividend for a minor portion of the year, and from this point of view alone, without entering into the advantages in rearing chickens on fresh ground each season, the poultry breeder who prefers to face the weather and greater labour with his flock scattered in smaller units may prove the wiser man. The cost of small portable hover houses is considerably less, and they can be in constant use for one purpose or another throughout the year. They are easily transferred to fresh ground and can consequently be stocked to their fullest capacity at all seasons.

Poultry farm costings have up to the present time been very incomplete, and the relative cost of different methods, taking into full account the labour and efficiency in results over a period of years, as well as the capital outlay, offers a wide field for investigation.

Poultry keeping has increased to a large extent upon general farms, and the farmer has special facilities for cheap housing and at the same time for utilising the fowls for the benefit of his land. A shelter may be constructed of fir poles, with the walls of bracken packed between two layers of wire netting, and straw on the roof. This is all that is necessary for poultry stock of all classes during the next five months of the year at least. The frame will last many years while the walls can be renewed as this becomes necessary. It is surprising that these shelters have not been more generally adopted on poultry farms to meet the temporary increases in stock during the rearing season.

Bacillary White Diarrhœa.—Less has been heard than usual of the troubles caused by bacillary white diarrhœa amongst chickens this season. Whether this indicates a decrease in the disease or a more correct diagnosis of the various ills with similar symptoms it is impossible to say. Nevertheless, many cases have occurred and heavy losses been experienced. An authentic case which has received careful investigation recently serves to illustrate the risks which may be run upon the introduction of fresh stock, even through hatching eggs, and the value of rapid and stringent action to combat the trouble at the outset.

On the farm in question a new breed was to be added. Several hundred eggs were purchased and delivered in two consignments, which were set with an interval of eight days between. Unfortunately the purchased eggs (Breed A) were mixed with a number of the home-bred stock (Breed B) in several compartments of a mammoth incubator. The first hatch duly turned out, and consisted of four compartments of the mixed A and B eggs and one compartment of B eggs.

Orders for day-old chicks of Breed B (the home-bred stock) were dispatched from the compartments of mixed A and B eggs, and a certain number of the B chicks remaining over were placed in a brooder house with the chicks of Breed A. For two days all went well, but at this stage deaths occurred, and within 48 hours the losses assumed alarming proportions. Post-mortem examination revealed the bacillus (*B. pullorum*) causing bacillary white diarrhœa, and precautions were at once taken to prevent the trouble spreading by isolation of the infected chicks and a thorough disinfection of all appliances with which they had come in contact.

Adverse reports were also received of the day-old chicks sent away, and full inquiry revealed parallel experiences in all but one instance. The more fortunate purchaser of chicks from the fifth compartment which had not been in contact with the purchased eggs had escaped trouble. With this one exception the whole of the chickens from this hatch died or were eventually destroyed.

In the second hatch the purchased eggs had been similarly mixed with home-bred eggs, and these were due to hatch within a few days of the outbreak. Action was at once taken, the purchased eggs all being removed to a compartment by themselves, a few being withdrawn for examination. The remaining compartments concerned were disinfected and the home-bred eggs replaced after the shells had been wiped over with methylated spirit.

Of the chicks from this hatch 60 per cent. of Breed A died within a few days. The losses from the batch of home-bred (B) chicks, of which there were approximately 200 chicks, was normal in the first week, amounting to 2 per cent. When examined at this period the chicks were big, strong and healthy in general appearance, but signs of scour and pasting of the vent were apparent in a larger number of cases than is normal. The losses during the next fortnight amounted to 10 per cent., which was well above the average loss experienced on this farm amongst some 2,000 chicks hatched before the outbreak, and it is surmised that they were affected slightly.

Amongst other points in this case it is of interest to note that infection was found to be present in the eggs of Breed A withdrawn from the second hatch and sent for post-mortem examination.

The mistake of the breeder in the first instance in failing to isolate the eggs in the incubator is important to note. It is generally recognised in our very imperfect knowledge of this and other diseases that infection is frequently carried in the egg and spread by the newly hatched chick. But for the prompt action taken as soon as the trouble was suspected, the disease might have spread and caused far greater losses. In this connection the fact that each hatch of chickens on the farm is placed in a brooder house to itself was of assistance in limiting the trouble. On the other hand much anxiety was felt with regard to the incubator; the disinfection of the affected compartments had to be carried out with the machine in full going order, and this prevented the use of formaldehyde gas, especially valuable for disinfection in such cases.

Lack of system and hesitation to act upon the outbreak of disease are often responsible for much of the heavy loss sustained upon poultry farms.

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JUNE ON THE FARM.

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Weather.—June is the first month of the summer quarter and perhaps the most pleasant of the twelve. It is characterised by the maximum duration of bright sunshine, high temperature—but not so hot as July—and moderate rainfall. During June, grass and corn make rapid growth and come into ear; the root crops begin to cast a green shade over the fields that were

apparently bare in May; and all kinds of livestock now show the benefits of a grass diet and an out-door life.

Insects often cause trouble in June: the turnip flea, the mangold fly, and the aphis may attack the root crops; the frit fly if present makes the oat crop " segg "; while in the livestock department the maggot, the warble and the bot flies worry sheep, cattle and horses respectively. Warm conditions favour insect life; but the corn grower's results depend considerably on fine dry weather about the end of the month. A cold, damp spell while cereals are in bloom may reduce the yield of grain by many bushels per acre. Wheat and barley are probably more susceptible to cold and damp than oats; but rye—being cross-pollinated—is even more dependent on fine weather at the flowering stage than wheat or barley. In some parts of Europe hail frequently works havoc among corn crops after the shooting stage—a risk that is in many districts provided against by co-operative insurance.

Grazing.—There are various ways of managing stock out at grass. In a few cases farm animals of all kinds and ages have free range over the entire area of pasture; but where methodical grazing is practised, the fences, gates and waterings are kept in good enough condition for the animals to be confined in the fields allotted to them for the time. Under good management, the economic requirements of the various classes of stock are as far as practicable arranged for: cows in full milk or forward bullocks are given the best bite; calves, yearlings and stirks, or a less forward lot of bullocks, have the second quality of grazing; while the dry cows and heifers, or lean stores come last in the series.

A very common arrangement of the grazing on dairy farms is to allot the pastures to the several classes of stock, somewhat in accordance with their requirements as above stated. As a rule the pastures farthest from the homestead are in lower condition than the home fields; the former are continuously grazed by the dry stock, the cows being conveniently kept nearer home, where also there is the best grazing. The cow pastures are commonly further divided into day fields and night fields, the latter being those adjoining the cow sheds in order that time may be saved in bringing the cows up for early morning milking. Where possible the cool, shady pastures are reserved for grazing in the daytime during hot weather.

An alternative method of grazing is that of eating off each field or area in rotation, depasturing it with the different classes

of stock in successive periods. The whole area of pasture land is mentally divided into three or four lots; the stock are rotated round the farm, the best cattle leading and each class of stock spending about 10 days in each lot. Thus a given field or group of fields is grazed for 10 days by the milkers, then for similar periods by the dry and young stock, and lastly it is rested for 10 days. At the end of the resting period the milkers come into the first field again and consume the fresh clean growth.

The rotation plan requires more detailed attention than that of continuous grazing, the duration of the grazing periods having to be varied according to requirements, to ensure even grazing or a fairly regular flow of milk; the grassland must be of reasonably uniform quality, over the whole of the farm; and when the cows are in distant fields, it is not so convenient for milking, especially in the mornings. The advantages claimed for rotation grazing are, however, that it ensures more even consumption of the entire herbage and that it enables the pastures to carry a heavier head of stock. The grass makes a remarkable recovery during the latter part of the resting period, growth being proportional to the area of leaf surface.

Another method of ensuring progressive grazing, which is customary in Denmark for instance, is that of tethering. The writer has seen over 100 dairy cows tethered in one field, a cowman spending much of his time in moving the tether-stakes and watering the animals. The young stock are more commonly allowed to range.

Turning Out Calves.—While the practice of keeping spring-born calves indoors all their first year is adopted by a number of good breeders, there are others who believe that grazing during the first summer is a desirable preparation for the following grass season. The housed calf may appear to have made better progress up to the age of 12 months; but another that has learnt to graze as a calf, it is held, makes the better animal in the end. Experimental evidence on this point is not available; but it is generally agreed that discretion must be exercised in the matter of the time when the calves are to begin lying out of doors. They easily contract chills and lose condition, if the change from indoor to outdoor conditions is made suddenly, especially when the nights are cold. For calves of dairy breeds dropped after February, June is early enough to begin turning out, and box food should be continued until they are six months old.

Arable Land.—June is normally an important weeding month. In corn there may be thistles to be spudded and docks to be drawn out before the crop is too high. Sometimes the docks pulled up are not burnt, and frequently they seed, in spite of having been lifted out of the ground. Horse hoeing performed in this month with a view to the destruction of weeds, the aeration of the soil, and the conservation of moisture, is an essential feature of good green-crop cultivation. Occasionally the mistake is made of paring the soil down too close to the plants, leaving them perched on a narrow ledge of earth from which all the moisture quickly escapes. It is possible to hoe close to the line of plants without injury, unless the soil is too hard and dry; but for this work the implement must be equipped with special blades, such as those formerly made under the Goss and Savage patents. But whatever type of blade is used, any deep drill-grubbing necessary should be completed early in the summer, as at the ordinary time for the third horse-hoeing in July the root fibres may be too near the surface to allow of more than superficial stirring.

The first side-hoeing and singling of mangolds may by this time be completed in the earlier districts; but generally this crop and swedes make heavy demands on the labour supply right up to the time when all hands are required in the hay field. Undoubtedly root-cleaning operations could in many cases be accelerated by the fuller use of mechanical side-hoes. There are also hand-pushed appliances on the market with which a man can efficiently side-hoe 1½ acres per day where, with an ordinary Dutch hoe, he would hardly cover a third of that area.

As regards singling, no machine on the market can be so satisfactory as good hand labour, as even the best machine can only make gaps in the row of plants, the actual singling having to be done by hand. Possibly too great stress is laid upon the desirability of absolute regularity of spacing and on adherence to what is thought to be the correct distance between the plants: experiments have failed to provide a satisfactory answer to the problems of what are the best distances at which to single. Of the desirability of the early removal of the surplus plants, however, there is no question; on which account the shortcomings of the mechanical thinner may be less serious than the delay due to shortage of hand labour.

MONTHLY NOTES ON FEEDING STUFFS.

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AN interesting series of observations is contained in a farmers' bulletin recently published by the Animal Husbandry Section of the Iowa Agricultural Experiment Station. The problem dealt with was the need for salt for ewes during the gestation period.

Rock Salt for Ewes.—It is a common practice in sheep feeding districts to allow sheep free access to rock salt. Observations were carried out by the Iowa Station extending over 7 years and covering no less than 28 flocks of ewes, in order to ascertain first, the amount of salt used by ewes during the winter period, and secondly the extent to which the ewes and resultant lambs benefited or deteriorated by the salt feeding. The ewes were allowed free access to salt. The highest daily consumption of salt per ewe was 0·8 oz., the lowest just over 0·1 oz. As would be expected, the demand for salt varied with the type of feeding stuffs given. The average consumption of salt worked out at 0·42 oz., or just under ½ oz. per head per day. An experiment was further carried out to test the effect of feeding salt to ewes. Four experimental comparable groups of ewes, 10 in each group, were fed from November, 1919, until lambing with the following amounts of salt per head per day. Lot 1. No salt. Lot 2. ¼ oz. Lot 3. ½ oz. Lot 4. 1 oz. The ewes averaged 124 lb. live weight at the commencement of the experiment. The average ration fed during the experimental period was grain 1 lb., maize silage 3 lb., mixed hay 1 lb. per ewe per day. The grain mixture consisted by weight of maize 20 parts, wheat bran 20 parts, linseed meal 10 parts. The mixed hay consisted of clover 9 lb., Timothy 1 lb. The following results were obtained :—

	Average daily gain per ewe.	No. of ewes lambing.	Fleece weight at shearing.	Loss in scouring per cent.
Lot 1.—No salt ...	·278 lb.	10	7·63 lb.	46
Lot 2.—Light salting...	·318 lb.	10	8·04 lb.	36
Lot 3.—Medium salting	·322 lb.	9	8·52 lb.	35
Lot 4.—Heavy salting	·311 lb.	9	7·65 lb.	39

DESCRIPTION.	Price per Qr. s. d.	lb.	Cwt. s. d.	Ton. £	s.	Value per Ton. £	s.	Food Value per Ton. £	s.	Equiv. per 100 lb.	Unit Starch Equiv. s.	per lb. Starch Equiv. d.
Wheat, British	—	—	11/3	11	5	0	16	10	9	71·6	2/11	1·56
Barley, British Feeding	—	—	10/9	10	15	0	12	10	3	71	2/10	1·52
„ Canadian No. 4 Western	34/–	400	9/6	9	10	0	12	8	18	71	2/6	1·34
„ Argentine	35/9	„	10/–	10	0	0	12	9	8	71	2/8	1·43
„ Tunisian	30/3	„	8/6	8	10†	0	12	7	18	71	2/3	1·20
„ Persian	31/3	„	8/9	8	15	0	12	8	3	71	2/4	1·25
„ Karachi	34/3	„	9/7	9	12	0	12	9	0	71	2/6	1·34
Oats, English, White	—	—	10/4	10	7	0	14	9	13	59·5	3/3	1·74
„ „ Black and Grey	—	—	10/–	10	0	0	14	9	6	59·5	3/2	1·70
„ Canadian No. 2 Western	26/3	320	9/2	9	3	0	14	8	9	59·5	2/10	1·52
„ „ No. 3 „	25/3	„	8/10	8	17	0	14	8	3	59·5	2/9	1·47
„ Canadian Feed	24/–	„	8/5	8	8	0	14	7	14	59·5	2/7	1·38
„ Argentine	22/–	„	7/8	7	13	0	14	6	19	59·5	2/4	1·25
„ Chilian	27/3	„	9/6	9	10	0	14	8	16	59·5	2/11	1·56
Maize, American	41/6	480	9/8	9	13†	0	13	9	0	81	2/3	1·20
„ Argentine	42/–	„	9/10	9	17	0	13	9	4	81	2/3	1·20
„ Galatz-Foxanian	41/9	„	9/9	9	15†	0	13	9	2	81	2/3	1·20
„ Karachi	42/6	„	9/11	9	18	0	13	9	5	81	2/3	1·20
Beans, English Winter	—	—	10/7	10	12	1	13	8	19	67	2/8	1·43
„ Rangoon	—	—	10/–	10	0†	1	13	8	7	67	2/6	1·34
Peas, Japanese	—	—	23/9	23	15†	1	9	22	6	69	6/6	3·48
Millers' Offals:—												
Bran, British	—	—	—	7	17	1	7	6	10	45	2/11	1·56
„ Broad	—	—	—	8	12	1	7	7	5	45	3/3	1·74
Middlings Fine (Imported)	—	—	—	9	10	1	3	8	7	72	2/4	1·25
„ Coarse (British)	—	—	—	8	17	1	3	7	14	64	2/5	1·29
Pollards, Imported	—	—	—	6	15†	1	7	5	8	60	1/10	0·98
Meal, Barley	—	—	—	10	7	0	12	9	15	71	2/9	1·47
„ Maize	—	—	—	11	10	0	13	10	17	81	2/8	1·43
„ „ Germ	—	—	—	9	5	0	19	8	6	85·3	1/11	1·03
„ „ Gluten-feed	—	—	—	9	7	1	8	7	19	75·6	2/1	1·12
„ Locust Bean	—	—	—	8	5	0	10	7	15	71·4	2/2	1·16
„ Bean	—	—	—	13	0	1	13	11	7	67	3/5	1·83
„ Fish	—	—	—	20	0	4	8	15	12	53	5/11	3·17
Linseed	—	—	—	19	15	1	12	18	3	119	3/1	1·65
„ Cake, English 12°/₀ Oil	—	—	—	12	0	1	19	10	1	74	2/9	1·47
„ „ 10°/₀ Oil	—	—	—	11	5	1	19	9	6	74	2/6	1·34
„ „ 9°/₀ Oil	—	—	—	11	2	1	19	9	3	74	2/6	1·34
Cottonseed Cake, English 5½°/₀ Oil	—	—	—	8	5	1	16	6	9	42	3/1	1·65
„ „ Egyptian 5½°/₀ Oil	—	—	—	7	17	1	16	6	1	42	2/11	1·56
Decorticated Cotton Seed Meal 7% Oil	—	—	—	12	10†	2	16	9	14	71	2/9	1·47
Coconut Cake 6°/₀ Oil	—	—	—	9	5	1	11	7	14	73	2/1	1·12
Palm Kernel Cake 6°/₀ Oil	—	—	—	7	0†	1	5	5	15	71·3	1/7	0·85
Feeding Treacle	—	—	—	7	5	0	8	6	17	51	2/8	1·43
Brewers' Grains:—												
Dried Ale	—	—	—	7	15	1	5	6	10	49	2/8	1·43
„ Porter	—	—	—	7	5	1	5	6	0	49	2/5	1·29
Wet Ale	—	—	—	1	14	0	9	1	5	15	1/8	0·89
„ Porter	—	—	—	1	8	0	9	0	19	15	1/3	0·67
Malt Culms	—	—	—	8	0†	1	15	6	5	43	2/11	1·56

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of April and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are

LAMBING RECORD.

	Average live lambs per ewe.	Average weight per lamb.
Lot 1	1·6	8·8 lb.
Lot 2	1·3	10·3 lb.
Lot 3	1·6	10·1 lb.
Lot 4	1·4	9·2 lb.

It will be seen from the above data that all the flocks receiving salt made better gains than the no salt flock, that the lightly salted and medium salted flocks made better gains than the heavily salted flock, that the lightly salted and medium salted ewes produced the best lambs, and finally, that the lambs which showed the largest growth or size at birth were found in the salted flocks.

The practical conclusions to be drawn from the above observations are:—

(1) That it pays to allow ewes free access to a salt lick.
(2) That if hand fed, *i.e.*, mixed with food, $\frac{4}{5}$ oz. of salt per day is the right amount per ewe.
(3) That the quantity of salt required will vary with the nature of the foods fed.

It is suggested that the salt should be kept in boxes to which the ewes have free access, and that these boxes should be protected from the weather.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat - - - - - -	1·20	2 3	71·6	8 1	0 16	8 17
Oats - - - - - -	1·20	2 3	59·5	6 14	0 14	7 8
Barley - - - - - -	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes - - - - -	1·20	2 3	18·0	2 1	0 4	2 5
Swedes - - - - -	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds - - - - -	1·20	2 3	6·0	0 14	0 3	0 17
Good Meadow Hay - -	1·43	2 8	31·0	4 3	0 14	4 17
Good Oat Straw - - -	1·43	2 8	17·0	2 5	0 7	2 12
Good Clover Hay - -	1·43	2 8	32·0	4 5	1 1	5 6
Vetch and Oat Silage - -	1·34	2 6	14·0	1 15	0 7	2 2

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending May 14th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	..	13.12	14. 2	18. 3
" " Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N. 20⅗ per cent.)	14. 2*	14. 2*	14. 2*	14 2.*	(N)13. 7
" " " neutral (N. 21¼ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5
Kainit (Pot. 12½ per cent.)	...	..	...	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
" " (Pot. 20 per cent.)	...	2.10	...	2.17	2.10
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.)	...	...	2.10	2.15	2. 9
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7. 7	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 28 per cent.)	...	2. 4§	...	...	...
" " (T.P. 26 per cent.)	...	2. 0§	...	...	...
" " (T.P. 24 per cent.)	...	1.16§	2. 0§	..	...
" " (T.P. 18 per cent.)	...	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.15	2. 2
" (S.P. 30 per cent.) ...	3.16	3. 7	3. 8§	3. 7	2. 3
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8.15	7.17	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17	6.15†	6. 0	6. 2†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	...	13.10	...	...
" " (N. 9, T.P. 10 per cent.) ...	...	...	...	13. 0	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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Agricultural and Veterinary Research Scholarships.

RESEARCH scholarships in agricultural and veterinary science, of the value of £200 per annum, tenable for three years from 1st October, 1924, will be awarded by the Ministry of Agriculture and Fisheries. Applications must be received by the Ministry not later than 15th July, 1924, and must be made on the prescribed form. The latter, together with a copy of the conditions attached to the scholarships, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. The number of scholarships awarded will not exceed seven.

Cockerel Distribution Scheme in East Sussex.

POULTRY breeders are devoting considerable attention to the influence of the male bird in improving the fecundity of mediocre flocks, there being evidence to show that a cockerel bred from a prolific female transmits the laying powers of his dam to his own female progeny. Schemes to enable poultry keepers to obtain cockerels from a good laying strain are, therefore, being considered in various parts of the country; and it is interesting to note that the Northampton Agricultural Education Sub-Committee has a distribution scheme of this character in preparation. The Cockerel Distribution Scheme of the East Sussex County Agricultural Committee, which has been approved by the Ministry as an experiment, has been organised, however, with a quite different object. Sussex, as a centre for the production of table poultry, is finding that the general concentration on egg production makes it increasingly difficult for breeders there to obtain the class of cockerel they require. The East Sussex Scheme aims, therefore, at the distribution, from each of two selected centres, of 50 approved cockerels which will be suitable as regards breeding and type for improving the class of bird used for fattening purposes. The Scheme which started last month will be in operation up to November next; and the cockerels are intended for distribution to the same class of poultry keepers as is eligible to participate in the Ministry's Egg and Day-Old Chick Distribution Scheme. The birds will be supplied at the following prices:—12 weeks old, 8s.; 18 weeks, 15s.; and 24 weeks, 20s.; a subsidy of 4s. being paid to the station-holders in respect of each cockerel supplied. Further particulars of the scheme can be obtained from the Director of Education, County Hall, Lewes.

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Travelling Research Fellowships in Agricultural Science.

THE Ministry has awarded the following travelling research fellowships to research workers in agricultural science in the current financial year:—

1. A Fellowship of £250 to Mr. F. L. Engledow, of the Cambridge University Plant Breeding Institute, for a visit to the United States to investigate American work on barley genetics, cereal yield testing, and the quality, storage and production of wheat.

2. A Fellowship of £50 to Mr. E. S. Salmon, of the South Eastern Agricultural College, Wye, Kent, for a visit to Czecho-Slovakia to investigate the growing of hops in that country.

3. A Fellowship of £60 to Dr. A. G. Ruston, of Leeds University, for a visit to Switzerland and Denmark for the purpose of investigations into agricultural costings.

In addition, to the above Fellowships the Ministry has also been authorised to award grants for the first time to workers in agricultural science in this country, to enable them to represent Great Britain at International Conferences and Congresses. This new scheme is very welcome in view of the increasingly high reputation which British agricultural research is attaining among workers in other countries. It seems likely that this country will take the position in International Conferences of agricultural scientific workers that was held by Germany before the war. The grants awarded under this scheme in the present financial year are as follows:—

1. *Fourth International Conference of Pedology, Rome, May, 1924.* Grants of £35 to:—

Sir John Russell, Rothamsted Experimental Station.
Dr. B. A. Keen, Rothamsted Experimental Station.
Mr. G. W. Robinson, University College of North Wales.
Dr. N. M. Comber, Agricultural Department, Leeds University.

2. *Second World's Poultry Congress and Exhibition, Barcelona.* A grant of £35 to:—

Professor R. C. Punnett, Department of Genetics, Cambridge University.

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Stud Goat Scheme.

GOAT keepers are informed that a scheme for the payment of premiums on approved stud goats in respect of services of female goats at a low fee is now in operation under the auspices of the British Goat Society. The scheme has been approved and will be financially assisted by the Ministry. The object of the scheme is to improve by means of breeding the productive quality of milch goats kept by small-holders, cottagers and other persons of a similar position. Stud goats will be registered by the British Goat Society as eligible for premiums under the scheme on the fulfilment of certain specified conditions, particulars of which may be obtained from the Society. The owner of the stud goat need not necessarily be a member of the British Goat Society. A leaflet explaining the scheme

has been issued by the Society, and goat keepers who are interested should apply at once to the British Goat Society, 5, Fenchurch Street, London, E.C.3, for a copy of it and for any further information required. Applications for the registration of stud goats should be made direct to the Society not later than 15th June next.

The Ministry trusts that this scheme may be successful in raising the quality of goats kept by persons of small means. There is room for the extension of goat-keeping in suitable districts; one of the chief drawbacks is that the he-goats used for service are often of indifferent quality owing to the difficulty of obtaining the use of first-class males at low fees. Under the new scheme small goat keepers will have security that an approved stud goat is of high quality, and that female kids from this goat will be well worth rearing. The fee charged must not exceed 5s., and the scheme is open to all those who own female goats, whether members of the British Goat Society or not, provided they come within the category of the small-holder or cottager class.

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Farm Wages in U.S.A.

THE February issue of the *Monthly Labour Review* of the United States Bureau of Labour Statistics contains an interesting table showing the course of farm wages since 1913. It is apparent that economic conditions during the latter years of the war and the period immediately following the Armistice affected the American Continent in much the same way as they did European countries. Wages rose steadily from 1915 onwards, reaching their zenith in 1920, after which a rapid decline is recorded.

The following table shows the percentage increases in the wages of regular farm labourers not boarded on the farm as compared with the year 1914:—

1915	0.9	1918	63.3	1921	45.0
1916	9.8	1919	88.4	1922	39.9
1917	35.3	1920	117.4	1923	57.0

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The Agricultural Index Number.

PRICES of agricultural produce during April were on the average 53 per cent. above those in the corresponding month of the years 1911-1913, as compared with 57 per cent. in March and 61 per cent. in February. There has thus been a decline of 8 points, or about 5 per cent., in two months, a fall

very similar to that which occurred during the same period last year. Throughout this year, up to the present, prices have been slightly lower on the average than in 1923. The following table shows the percentage increases monthly since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

There has been a slow but steady advance in wheat prices since early in April and a less pronounced rise in prices of oats, but the rise is insufficient to make up for the fall which occurred during the previous month, and on the average prices were respectively 4d. and 3d. per cwt. lower in April than in March, the corresponding index numbers declining by 8 points and 4 points respectively. Barley moved irregularly, but on the whole was also cheaper by about 2d. per cwt than in March; falling average prices for home-grown barley are, however, usual at this time of the year, and the index number shows a rise of 3 points on the month.

Potatoes hardened in price gradually up to the middle of April, and then rose sharply, prices being 60s. or 70s. per ton higher at the end than at the beginning of the month. On the average of the whole month, however, prices were only about 16s. per ton higher than in March, and as a pronounced rise between March and April occurred in the basic pre-war years, the index number, in spite of the rise in prices, shows a fall of several points. Unless there is a substantial fall in potato prices during this month, however, the index number for potatoes will show a very steep rise in May, as the full effect of the recent advance in prices will be brought into play.

Hay remains at approximately its pre-war level, the slight hardening in prices during April being no more than is customary at this season.

Although cattle prices have shown practically no change from month to month throughout this year, the index number has declined steadily, due to the fact that prices are normally rising during the earlier months of the year. On the other hand, both sheep and pigs show a recovery this month, to about the February level, but they are still much cheaper than at this time last year.

For several months now, many of the store stock markets have been closed owing to foot-and-mouth disease and, although matters have recently improved, the fact that relatively few markets remain open somewhat invalidates the comparison of average prices of store stock with those of more normal times. So far as figures are available it appears that yearling cattle were cheaper in April than in March, but the fall was more than counterbalanced by the advance in the price of 2-year-olds. As store cattle are usually advancing in value at this season, however, the index number shows a slight fall. Similarly with sheep, the index figure is slightly lower in spite of a rise of about 3s. per head in average prices, while store pigs were cheaper, both actually and relatively, in April than in March, probably as a result of the continued depression in the market for fat pigs. Dairy cows have maintained the improvement recorded last month, and during April realised over 60 per cent. more than in pre-war days.

All kinds of poultry rose appreciably in April, and in spite of a normal rise in price before the war, the index number for April is decidedly higher than that for March. Eggs, on the other hand, continued their seasonal decline, and the fall was moreover relatively much greater than in pre-war years, the index number showing a drop of as much as 20 points, making a total fall of 37 points since January.

It is one of the most noticeable features of price movements in recent years, that seasonal fluctuations have been much more pronounced than before the war, in the case of all agricultural products which are subject to seasonal price variations. This is clearly seen in the case of poultry and eggs, and is also apparent in connection with prices of dairy produce. The average price of milk delivered to large towns during April was a fraction below 1s. per gallon, as compared with about 1s. 6¾d. during January and February. In pre-war years the summer and winter prices were respectively 7½d. and 10d. per gallon, a much smaller proportionate difference. Hence average prices paid for milk during April were only 58 per cent. above

those paid in the corresponding month in the years 1911-1913, while February prices were 87 per cent. above pre-war. Butter prices have similarly fallen decidedly more than was customary before the war, and at 51 per cent. above the level of April, 1911-1913, are 20 points lower than in February.

Index numbers of different commodities during recent months and in April, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. Apr.	1923. Dec.	1924. Jan.	1924. Feb.	1924. Mar.	1924. Apr.
Wheat ...	31	33	34	44	46	38
Barley ...	11	27	34	43	45	48
Oats	39	30	38	41	39	35
Fat cattle ...	51	49	56	54	52	49
Fat sheep ...	100	72	87	75	64	75
Fat pigs ...	71	43	43	34	33	35
Dairy cows ...	55	—	51	48	64	63
Store cattle ...	29	—	35	39	41	38
Store sheep ...	92	—	91	89	85	84
Store pigs ...	131	—	63	50	45	42
Eggs... ...	37	86	85	75	68	48
Poultry ...	75	77	60	52	59	70
Milk	70	90	87	87	71	58
Butter ...	68	68	68	71	63	51
Cheese ...	92	71	76	72	71	71
Potatoes ...	—28*	91	129	170	173	154
Hay	40	0	—1*	—1*	1	0

* Decrease.

Although on the whole the general level of prices of agricultural produce is little different from that of April last year, there are several changes in individual items which are of interest. Potatoes in April last year sold at nearly 30 per cent. below pre-war rates and are now at about two-and-a-half times pre-war prices. Hay, on the other hand, has fallen to its pre-war level. These changes are directly attributable to fluctuations in supply, the 1923 potato crop in England and Wales being less than 70 per cent. of the previous year's crop, while the hay crop was over 30 per cent. in excess of that of 1922. Apart from these commodities there is a general levelling up of prices. There is now no index number so high as the 100 per cent. excess over pre-war recorded for fat sheep last April, or the 92 per cent. for cheese; nor is there any commodity so cheap in comparison with pre-war as were wheat and barley in April of last year. The extreme range (potatoes and hay excepted) is now from 35 per cent. above pre-war, which is the figure for oats and fat pigs, to 75 per cent., the figure for fat sheep.

THE Minister of Agriculture and Fisheries has appointed a Committee to formulate, for the consideration of his department, a detailed scheme for individual tests of agricultural machinery as recommended by the Machinery Advisory Committee in their Report of 7th April, 1923.

The Testing of Agricultural Machinery.

The scheme is to include:—

(*a*) the general regulations governing the admission of machines and implements for testing;

(*b*) the special regulations governing particular groups or classes of machines and implements;

(*c*) the forms of entry to be submitted to the Ministry;

(*d*) the forms of certificates and reports to be issued by the Ministry;

(*e*) the scale of fees to be charged, having regard to the necessity of making the scheme, as far as possible, self-supporting.

The following have been appointed:—

Mr. W. E. Dalby, F.R.S., Professor of Engineering in the University of London;

Mr. Thompson Close, of the Ministry of Agriculture and Fisheries;

Mr. F. S. Courtney, M.I.C.E., M.I.M.E., Consulting Engineer to the Royal Agricultural Society of England;

Mr Henry Deck;

Mr. Harry German;

Mr. W. Harrison;

Mr. B. J. Owen, M.Sc., M.Eng., Director of the Institute for Agricultural Engineering, Oxford;

Mr. T. E. Stanton, C.B.E., D.Sc., F.R.S., of the National Physical Laboratory, Department of Scientific and Industrial Research.

Professor Dalby has been appointed Chairman and Mr. P. Barker, of the Ministry of Agriculture and Fisheries, Secretary of the Committee.

The Committee is empowered to co-opt, for the purpose of inquiry into any particular class or classes of machine or implement, or into any particular form of test, such person or persons whose knowledge may be of assistance.

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IT will be of interest to dog-owners and the public generally to learn that two cases of rabies have recently (in April) been confirmed by the Ministry in imported dogs whilst undergoing the prescribed quarantine on veterinary premises in accordance with the Ministry's regulations.

Rabies in Imported Dogs.

In one case the dog came from Egypt and the first symptoms appeared three days after arrival at the quarantine

station. From inquiries made it was ascertained that the dog had been used for hunting wild dogs and had been severely bitten about two months before the disease appeared.

In the other case the dog came from India and the first symptoms did not appear until the dog had been three months in quarantine. Allowing for the period of the voyage, this dog must have been bitten, therefore, at least four months before rabies appeared.

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The Fream Memorial Prize.

THE Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. Richard W. Thompson, a student of the Harper Adams Agricultural College. The value of the prize this year is about £7 10s., which is to be devoted to the purchase of books.

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Conciliation Committees in Agriculture.

THE agreement of the Cheshire Committee, which was due to terminate at the end of April, has been extended up to 31st October. The rate for adult male workers is 32s. for a week of 54 hours, with all overtime employment payable at the rate of 9d. per hour.

The Carnarvon Committee has decided that the existing agreement, with minor amendments, shall remain in force for the time being. Special class workers of 20 years and over living out receive 35s. for 61 hours per week (to include Sunday feeding and cleaning of stock), and those boarded and lodged on the farm, 33s. 6d. (including the value of board and lodging at the rate of 14s. for seven days, and 12s. for six days). The wages of other adult male workers are 30s. for a 50-hour week, and provision is made for the payment of harvest overtime at the rate of 9d. per hour.

The Denbigh and Flint agreement has been extended from 30th April last to 30th November. The terms provide for the payment of horsemen and stockmen at the rate of 33s. for 61 hours, and of other adult male workers at 27s. 1d. for 50 hours. A weekly half-holiday is recommended.

What amounts to an extension of the last agreement has been made by the Merioneth and Montgomery Committee, and the rates are to continue in operation until 31st October instead of 30th April, as previously. Stockmen are to receive 32s. for a guaranteed week of 60 hours, *i.e.*, an advance of 1s., whereas

the rates for ordinary adult male workers are 30s. for 54 hours, as compared with the former 28s. for 52 hours.

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IN the House of Commons on 7th May, Mrs. Wintringham asked the Minister of Health whether the reports of his inspectors showed that the public can rely on the high hygienic quality of the large quantities of milk described on sale as nursery, invalids, or guaranteed; and, if not, whether he would consider how the public may be safeguarded in the matter?

Special Milk Designations.

The Minister of Health (Mr. Wheatley) replied: "According to the information in my possession the answer to the first part of the question is 'No.' I will consider what steps it may be practicable to take to safeguard the public in this matter, but in the meantime I think the consumer would be well advised not to place too much reliance on descriptions and designations implying special hygienic qualities other than those authorised by the Milk (Special Designations) Order."

Mrs. Wintringham also asked whether the Minister of Health was aware that a large part of the milk sold as raw milk in our large cities has been pasteurised or otherwise treated by heat; and whether he was prepared to take steps to ensure that purchasers may know whether their milk has been so treated?

Mr. Wheatley replied: "Yes, Sir; and, while I am doubtful whether it will prove practicable to take effective steps in the direction suggested, I will consider the hon. Member's proposal. I am hopeful that the provisions of the Milk (Special Designations) Order, 1923, as to the use of the term 'pasteurised' may contribute to the enlightenment of consumers and lead to the disuse of unapproved processes."

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NOTICES OF BOOKS.

The British Goat Society's Year Book for 1924 (Issued by the Hon. Secretary, 5, Fenchurch Street, E.C. 3. Price 1s. 6d.) indicates that the Editor continues, with increasing success, to present a budget of information which is both useful and interesting. Doubtless the Year Book eventually reaches a much wider circle of readers than that of the Society's members alone, since the articles are so comprehensive as to provide almost sufficient material for an up-to-date text-book on the subject. The messages from the President, Lord Leverhulme, and the late President, Lord Dewar, show that the principal officers of the Society take more than a passive interest in its work, which is apparently directed, more and more, to the improvement of the cottager's goat, and the encouragement of goat-keeping as a means of supplying goats' milk of the highest quality in the homes of the poorer

people, at low cost. The article on intensive goat-keeping for the cottager should be of value to the many people who would like to keep milch goats but who are under the erroneous impression that considerable land for the animals to roam over is essential. The article on butter-making and cheese-making from goats' milk should enable many goat-keepers economically to utilise their surplus milk in the flush season. The scientific side of goat-keeping has not been neglected, and an article on genetics by Dr. Crew and another on skin diseases by Mr. H. Stainton are included.

Among the excellent photographs of goats is shown one of the Toggenburg stud goats imported in 1921, and two of his progeny. This successful importation is only one indication of the comprehensive policy adopted by the British Goat Society, which is now about to put into operation, with the approval and financial aid of the Ministry of Agriculture, a scheme for the provision of stud goats of good quality in England and Wales, for the benefit of the poorer goat-keepers. Already a number of the Society's members who breed high-class pedigree goats are members of the Ministry's Milk Recording Societies, and thus obtain reliable records of the individual milk yields of their goats. The aims of the British Goat Society, its constitution and rules, are set out in the Year Book, which altogether forms a most valuable book of reference for goat-keepers.

Profitable Poultry.—(E. Bostock Smith. London : The City and South London Printing and Publishing Co., Ltd. Price 1s.) This small book contains a good account of the Heaselands Poultry Farm and much sound practical advice. The photographs are excellent and illustrate not only the stock kept and the methods adopted at Heaselands, but incidentally depict some of the natural beauty of that district of Sussex. To those persons who are unfamiliar with modern poultry farms and who are considering the possibility of engaging in the industry, this book presents much interesting material, both from the technical and business standpoint. The author introduces so many sound business maxims with his book that its readers will no doubt understand that he has practised what he preaches, and that at Heaselands Poultry Farm efficient business methods are adopted.

The working drawings of poultry houses which are included in the book constitute a most useful amplification of the photographs, and will no doubt be much appreciated by those who prefer to build houses of the Heaselands type.

Diseases of Glasshouse Plants.—(W. F. Bewley, D.Sc., London: Ernest Benn, Limited, 1923, 208 pp., 12s. 6d. net.) The main object of this book, as is stated in its preface, is to provide for growers of crops under glass an account of the fundamental principles on which the control of disease in such crops is based. The book is intended to be of practical use to growers in the course of their business, and it may be stated that no one is more competent to write with knowledge and experience on this subject than the author, who is the well-known Director of the Experimental and Research Station of the Nursery and Market Garden Industries' Development Society, Ltd., at Cheshunt, Herts.

The first part of the book, which comprises the first two chapters, deals with the general conditions which govern cultivation under glass, and with the relation of these conditions to plant hygiene and to the incidence of disease. It is shown not only how maladjustment of such

environmental factors as light, temperature, moisture, etc., may result directly in unhealthiness or disease in the crop in the absence of any specific organism, but also how these factors may play a most important part in deciding whether or not infection with a parasite may occur and, if so, to what degree its ravages may extend. Two illustrative examples may be referred to here. Cucumbers grown in a house in which the soil temperature is low whilst that of the atmosphere is high are apt to wilt and die because the activity of the roots in the cool soil is not great enough to secure a supply of moisture sufficient to replace that transpired from the foliage. Again, in the case of tomatoes, unless soil temperature is maintained at or about 29°C. the wilt-producing fungus, *Fusarium lycopersici*, does not succeed in infecting the roots. These diseases, therefore, can be controlled by proper attention to the temperature factor.

Three chapters follow in which diseases due to specific pathogenic fungi are dealt with, and recommendations for their treatment are laid down. They are classified under the headings: (*a*) Root Diseases, (*b*) Wilt Diseases, and (*c*) Stem, Leaf and Fruit Diseases, and the principal hosts involved are the tomato, cucumber and melon, as well as the carnation, sweet pea and chrysanthemum. Space does not permit of detailed reference to individual diseases and the methods of controlling them, but mention may be made of a valuable method of dealing with the "damping off" disease of seedlings. This consists in watering the soil with "Cheshunt Compound," which is prepared by intimately mixing copper sulphate and ammonium carbonate in certain proportions and making a dilute solution of the resulting powder in water just before use. Although this treatment does not secure the recovery of seedlings already attacked, it does prevent the infection of further seedlings; and if applied to the soil after sowing and covering the seeds, it secures immunity for the seedlings when they arise.

In Chapter VI the more important diseases of glasshouse crops which are caused by bacteria are described. These include the cucumber "wilt" due to *Bacillus tracheiphilus*, a "foot-rot" of the cucumber and melon due to *B. carotovorus*, the "angular leaf-spot" of the cucumber, "stripe" disease of tomato, sweet pea, etc., and some others. Measures for control are also suggested. A good account of the so-called "mosaic" or "virus" diseases of the tomato and the cucumber is given and their infectious nature and mode of transmission explained.

The concluding chapters of the book are concerned with general reflections and considerations on disease treatment. The importance of water and soil sterilization is pointed out and practical details in connection with the carrying out of these processes are supplied. Useful information on spraying and dusting with the more important fungicides is given, and the methods of cleansing glasshouses are briefly described. The possibilities of breeding, selection and hybridization in regard to the production of resistant varieties are alluded to, and instances of success in this field of work given.

In an Appendix a list of diseases of the tomato is given, in which they are grouped according to whether they are common in England or only occasionally found here. There is added, in the form of a bibliography, a list of the original publications, which are referred to in the text.

The book is illustrated with nearly fifty figures, many of which take the form of well executed half-tone reproductions of photographs of typically diseased plants.

As already stated, the book is primarily intended for the grower, and it is therefore not overburdened with technical mycological descriptions and details. Nevertheless, not only the grower, but also the plant pathologist, may profit by a study of its pages.

Manuring of Market Garden Crops.—(Bernard Dyer, D.Sc., and F. W. E. Shrivell. London: G. Street & Co., Ltd. Price 1s. post free.) This is in the main a reprint of the volume published by Dr. Dyer and Mr. Shrivell, giving the results they obtained in manuring market garden crops on a poor clay loam soil at Hadlow, with the addition of two further years' results. These experiments provide a useful guide to the market gardener who is fortunate enough to be able to maintain a reasonable supply of dung to his land, but, with the exception of a few crops, are of little value where only very small supplies of dung are available.

An interesting feature is the addition of tables showing the results of growing certain vegetable crops without manure on the plots which had previously been manured in different ways. In general, both the plots which had received heavy annual dressings of dung, and those which had received light dressings of dung supplemented by fertilisers, gave two good crops—in the case of broccoli three—rather below the previous manured crops, and then fell off rapidly. Exceptionally beet, carrots and, possibly, parsnips, yielded as well in the fourth year as in the first, especially where the annual dressing of nitrate of soda had been as heavy as 6 cwt. per acre. An interesting sidelight is thrown on the use of potash. In the case of such potash-loving crops as the roots mentioned above, the residue of potash has proved beneficial where 2 cwt., or even 4 cwt., of nitrate of soda had been used, but was of no value, or was even harmful, where 6 cwt. had been used in conjunction with other fertilisers and dung. The results make it abundantly clear that while mineral fertilisers do not impoverish the land so much as is commonly supposed, yet their use cannot profitably be continued, for most crops, in the absence of dung or, presumably, some humus-forming equivalent.

Plants Poisonous to Live Stock.—(Harold C. Long. Cambridge and London: University Press. Price 8s. 6d.) This volume contains information on all flowering plants likely to prove poisonous to live stock on farms in the United Kingdom. The author states that "as in the case of a previous volume, *Common Weeds of the Farm and Garden*, the preparation of this handbook was undertaken because of the great lack of readily available and reliable information on the subject in English scientific literature," and, further, that "an endeavour has been made to give a sound but brief statement as to the present information on plants poisonous to live stock in the United Kingdom." Symptoms, toxic principles and many references to the literature on the subject are given in the case of almost every plant covered. The text relating to a number of species has been much amended since the earlier edition was published in 1917. A bibliography contains 267 numbered references.

The Resources of the British Empire: Food Supplies.—(Prof. J. R. Ainsworth-Davis. Part I: Crops and Fruit. Part II: Meat, Fish and Dairy Produce. London: E. Benn, Ltd., 1924. 21s. each volume.) These two volumes, part of a series of twelve prepared by

the Federation of British Industries, provide a valuable survey of the varied products derived from plants and animals. The principle adopted in the preparation of the series has been to combine information of practical value to business men. A considerable portion of the matter is necessarily statistical, but the explanatory passages and general summaries from the pen of so well known a writer as Professor Ainsworth-Davis make the volumes worthy of attention by all who are interested in the production and distribution of food products.

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QUESTIONS IN PARLIAMENT.

Land Drainage and Water Supply Schemes.—In reply to a question asked by Captain Terrell in the House of Commons on 5th May, as to whether the £100,000 promised towards land drainage and afforestation had been paid or promised, wholly or in part, the Minister of Agriculture, Mr. Noel Buxton, said that he presumed the reference was to the extra £105,000 allocated by the present Government to unemployment relief works during the expiring winter season of 1923-24, of which £60,000 was earmarked for land drainage and water supply schemes in England and Wales additional to the £250,000 already voted for that purpose. Completed schemes or schemes still in operation are estimated to absorb nearly £276,000 of this amount, and but for bad weather the whole £310,000 would undoubtedly have been expended.

Wages of Agricultural Workers.—In the House of Commons on the 12th May, Mr. Lambert asked the Minister of Agriculture if he would give particulars of the circumstances where an inspector of the Board found that two agricultural workers were working 63 hours and 53 hours per week for a wage of 20s., and where one labourer was receiving 17s. per week?

Mr. W. R. Smith, Parliamentary Secretary to the Ministry of Agriculture, replied that in one case the man was a farm worker and milker working 62 hours a week, including Sundays, and in the second he was a general farm labourer working 52 hours per week. Both these men were able-bodied and married. No details were available of the circumstances relating to the man who is receiving 17s. per week, as he was not among those interviewed personally by the Ministry's inspector.

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Foot-and-Mouth Disease.—The position continues satisfactory, the numbers of outbreaks during the weeks ended 4th, 11th, and 18th May being 9, 11 and 13 respectively, occurring in the following counties, viz. :—

Beds. ...	1	Norfolk ...	1	Yorks. W.R. ...	1
Denbigh	1	Northumberland	6	Yorks. N.R. ...	2
Lancs. ...	2	Notts.	1	Ayr	2
Leics. ...	2	Salop	3	Perth	1
Lincs. Kesteven ...	1	Staffs.	3	Renfrew ...	1
		Warwick ...	4		

Of these outbreaks, those at Oswestry on 2nd May, Stotfold, Beds., on 3rd May, Sheffield on 5th May, Willoughby, Rugby, on 8th May, and Ponteland, Northumberland, on 12th May, and Grantham, Kesteven, on 17th May, all necessitated the extension of the areas under restrictions in the respective districts, whilst that at Arngask, Perth, which occurred on the 13th May, occurred on premises on which

an outbreak had previously been dealt with by isolation. In this case the last arrival on the premises had recovered from the disease on 7th December, and restrictions were withdrawn on 14th March. The animal now affected did not take the disease on the previous occasion.

The number of outbreaks from the commencement of the outbreak on 27th August to 18th May is 3,087, involving the slaughter of 103,923 cattle, 43,578 sheep, 47,986 pigs and 128 goats, and the payment of approximately £3,292,000 in compensation.

Leaflets issued by the Ministry.—Since the date of the list given on pages 205-206 of the May issue of the *Journal*, the following leaflets have been issued:—

Revised, No. 112.—Weeds and their Suppression.
No. 202.—The Frit Fly.
No. 265.—Rabbit Keeping.
Re-written, No. 31.—The Onion Fly.

French Colonial Exhibition at Strasbourg.—An industrial and agricultural exhibition will open at Strasbourg on 1st July next. The main object of the exhibition is to display the products that the French colonies can supply to the mother country, and those that home industry and commerce can furnish for export in return. Another section will contain a special exhibit of the products of Alsace and Lorraine.

The agricultural classes will contain exhibits of agricultural, horticultural and forest produce of France and the French colonies, comprising food products, tropical produce such as coffee, cocoa, etc., raw materials for manufacture such as rubber and cotton, machinery and equipment.

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ADDITIONS TO THE LIBRARY.

[Readers of the JOURNAL who are not aware that certain books and agricultural periodicals may be borrowed from the Ministry's Library should write to the Ministry for particulars and conditions of loan.]

Field Crops.

University College of North Wales.—Varieties of Oats, 1923. (11 pp.) Bangor, 1924. [63.314.]

University College of North Wales.—Experiments with Potatoes, 1919-1923. (16 pp.) Bangor, 1924. [63.512.]

Welsh Plant Breeding Station.—Series H, No. 2:—The Artificial Hybridisation of Grasses, *T. J. Jenkin.* (18 pp.) Aberystwyth: University College of Wales, 1924, 3s. 6d. [63.33; 63.1952.]

Kentucky Agricultural Experiment Station.—Circular 29:—Self-Fertility in Red Clover: A Report of Progress on an attempt to secure Self-Fertile Lines in this Crop. (20 pp.) Lexington, 1922. [63.33(*b*).]

Horticulture and Fruit Growing.

Macself, A. J.—Grass for Ornamental Lawns and all purposes of Sports and Games. (204 pp.) London: Cecil Palmer, 1924, 15s. net. [63.53(02).]

Rowles, W. F.—Greenhouses: How to Make and Manage Them. (124 pp.) London: C. A. Pearson, Ltd., 1924, 1s. 6d. net. [69: 63.5-19.]

Udale, J.—The Handy Book of Pruning, Grafting and Budding. Sixth Edition. (146 pp.) London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1924, 2s. net. [63.41-195.]

Michigan Agricultural Experiment Station.—Special Bulletin 127:—Nitrogen-Carrying Fertilizers and the Bearing Habits of Mature Apple Trees. (32 pp.) East Lansing, 1924. [63.41(*a*).]

Plant Pests and Diseases.

International Conference of Phytopathology and Economic Entomology, Holland, 1923.—Report. (290 pp. and 16 plates.) Wageningen: T. A. C. Schoevers, Committee of Management. [63.2(02).]

Kansas Agricultural Experiment Station.—Bulletin 231 :—Potato Diseases Control in Kansas. (45 pp.) Manhattan, 1924. [63.24-33.]

U.S. Department of Agriculture.—Farmers' Bulletin 1367 :—Control of Potato Tuber Diseases. (37 pp.) Washington, 1924. [63.24-33.]

Live Stock.

Lancashire County Council, Education Committee, Agricultural Department.—Farmers' Bulletin 39 :—Report on Pig-Feeding Trials, 1920-23. (28 pp.) Preston, 1924, 1s. [63.64 : 043.]

Tod, W. M.—Hints on Feeding : A Practical Book on the Feeding of Livestock for the Farmer, Dairyman and Pig-Keeper. Second Edition. (300 pp.) London : Macdonald & Martin, 1924, 7s. 6d. [63.6043(02).]

Veterinary Science.

Long, H. C.—*Plants Poisonous to Live Stock.* Second Edition Revised. (120 pp.) Cambridge : University Press, 1924, 8s. 6d. net. [619(02) : 63.255(02).]

Bees.

U.S. Department of Agriculture.—Department Bulletin 1222 :—Growth and Feeding of Honey-bee Larvæ. (37 pp.) Washington, 1924. [63.81.]

Engineering.

Kranich, F. N. G.—Farm Equipment for Mechanical Power. (420 pp.) New York and London : Macmillan Co., 1923, 12s. 6d. net. [63.17(02).]

Crabbe, E.—The Handy Man on the Holding. (125 pp.) London : C. A. Pearson, Ltd., 1924, 1s. 6d. net. [62(02) 69(02).]

Economics.

Ainsworth-Davis, J. R.—Food Supplies. Part I : Crops and Fruit. Part II : Meat, Fish, and Dairy Produce. (*The Resources of the Empire Series.*) London : Ernest Benn, Ltd., 1924, 21s. net each volume. [31; 338.9.]

Independent Labour Party.—A Socialist Policy for Agriculture. (32 pp.) London : I. L. P. Information Committee, 1924, 6d. [338.98.]

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SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

The Liming of Land, *J. Augustus Voelcker* (Jour. Farmers' Club, March, 1924, pp. 19-38). [63.15.]

Tar, Smoke, and Coal Gas as Factors inimical to Vegetation, *J. H. Priestley.* (Science Progress, XVIII (1924), No. 72, pp. 587-596.) [614.7.]

Field Crops.

Modern Wheats, *R. H. Biffen.* (Jour. Farmers' Club, 1924, Part I, pp. 1-18.) [63.311.]

Methods now in Use in Cereal Breeding and Testing at the Cornell Agricultural Experiment Station, *H. H. Love* and *W. T. Craig.* (Jour. Amer. Soc. Agron., XVI (1924), 2, pp. 109-127.) [63.195; 63.31.]

Investigations on Yield in the Cereals, I, Part II (*continued*), *F. L. Engledow* and *S. M. Wadham.* (Jour. Agr. Sci., XIV, 2, April, 1924, pp. 287-324.) [63.31.]

Field Experiments in Electro-Culture, *V. H. Blackman.* (Jour. Agr. Sci., XIV, 2, April, 1924, pp. 240-267.) [537.]

Pot Culture Experiments with an Electric Discharge, *V. H. Blackman* and *A. T. Legg.* (Jour. Agr. Sci., XIV, 2, April, 1924, pp. 268-286.) [537.]

Live Stock.

Iron Deficiency in Pigs, *J. P. McGowan* and *A. Crichton.* (Biochem. Jour., XVIII (1924), 1, pp. 265-272.) [612.394.]

Praktische Futterungsversuche mit Schweinen über die Wirkung von Fischmel im Vergleiche zu anderen eiweissreichen Futtermitteln, *J. Landis....* (Landw. Jahrb. Schweiz, 1923, eft 5, pp. 595-644.) [63.64 : 043.]

Economics.

Agricultural Production in Denmark, *H. Faber.* (Jour. Roy. Stat. Soc., Jan., 1924, pp. 22-75.) [63(489); 31(489).]

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NOTES FOR THE MONTH.

Agricultural Tribunal of Investigation—Final Report.

THE Agricultural Tribunal consisting of Professor W. G. S. Adams, Sir William Ashley and Professor D. H. MacGregor, with Mr. C. S. Orwin as Agricultural Assessor, and Mr. D. B. Toye as Secretary, has issued its Final Report.* The terms of reference to the Tribunal were as follows:—

> "To inquire into the methods which have been adopted in other countries during the last fifty years to increase the prosperity of agriculture and to secure the fullest possible use of the land for the production of food and the employment of labour at a living wage, and to advise as to the methods by which those results can be achieved in this country."

Interim reports were issued on 29th March, 1923, and 10th November, 1923, respectively. The Final Report comprises two separate reports, the one by Professor Adams and Sir William Ashley, and the other by Professor MacGregor. The Tribunal point out in their covering letter that while on some matters the two Reports represent different points of view, they should also be regarded largely as supplementary one to the other, each Report treating certain aspects of the problem more fully than the other.

The report by Professor Adams and Sir William Ashley, in comparing British with Foreign agriculture, draws attention to the remarkable decline which has taken place in this country in

* Obtainable from H.M. Stationery Office, Kingsway, W.C. Cmd. 2145; price 5s.

(55579) P.6./R.4. 8,750. 7/24. M. & S. A

the last fifty years in cereal crops and in roots. In foreign countries there has been on the whole an increase in the arable areas; at least it has been maintained. With regard to employment in agriculture, there has been a relative decline in agricultural employment in all countries and in Great Britain the absolute decline has been greater than in other European countries. The wages of agricultural labour in Great Britain were before the War, and still are, higher than in most European countries. The Members of the Tribunal do not consider, however, that the better position of the agricultural worker in this country is any argument against the re-establishment of Wages Boards; in fact they state that it is only by increasing the wages of agricultural labourers and improving their housing conditions that it will be possible to stop the rural migration, whether to the towns or to the Colonies. They therefore recommend that District Wages Committees should be instituted on the lines recommended in the First Interim Report, and that consideration should be given to the possibility of making special grants in aid of the housing of agricultural workers.

With regard to tenure, it is suggested that the Government should institute an inquiry into the possibility of the extension of the "Evesham Custom" to all agricultural tenancies.

The Report observes that nothing stands out more markedly in a comparison of British and foreign agriculture than the backwardness of co-operation in this country. It is true that in distant countries relying on export to foreign markets a special incentive is upon the farmer to co-operate, but this will not account for the backwardness of England. It recommends that the Government should continue to provide funds for propaganda in aid of co-operation.

With respect to credit, it is suggested that Farm Loan Boards should be established, enjoying defined autonomy up to prescribed financial limits and that these Boards should be the authority responsible for assistance to co-operative societies within their district. The Report states that the Tribunal are satisfied that the time has come for a fresh and large effort to be made to extend small holdings, and Professor Macgregor, in his Report, indicates a scheme which might now be put into operation.

Other recommendations cover agricultural education and research (for which it is suggested that more funds should be

made available), co-operative insurance, administrative organisation and the Councils of Agriculture, and experiments in arable stock farming.

Finally, the Adams-Ashley Report observes that under Free Trade Great Britain can only maintain its arable area by going over to arable stock farming, and this, under present conditions, English farmers have no pecuniary inducement to do, as they can make farming pay by laying down their land to grass. It is recommended, therefore, that the Government should undertake experiments on a large scale to demonstrate whether arable stock farming in this country can be a financial success.

The report by Professor MacGregor observes that there is no ground for depreciation of British agriculture as a whole, in view especially of the great development of our manufactures. British agriculture does not suffer by an international comparison of existing efficiencies with respect to either (*a*) the actual produce of the soil, or (*b*) the level of wages paid. The fundamental difference between British and foreign agriculture is not the efficiency but the size of this industry in relation to all industries. Lines of agricultural policy which might be pursued are then indicated.

The maintenance of arable cultivation will increase the opportunity of employment in agriculture, but its expense could not be justified on this ground alone, but only by exigencies of defence. If the Government is not advised that there is an exigency which justifies a heavy annual charge in favour of arable farming the whole argument disappears.

The experience of European countries with a national economy similar to our own, shows the difficulty of maintaining agricultural employment even where strong measures of protection are added on to a system of high organisation. Is the possibility of a decline to a million men and between 30 and 40 per cent. of arable land already so serious that the gradient should be lessened *now* at the cost of a battleship per annum? Or is a home agriculture of this size and form, in relation to our shipping and colonial assets, an adequate basis to work from? If no present urgency is pressed on the Government by its military advisers, then alternatively either 12 million acres of arable, or a million men over 15 employed, might, it is suggested, be taken by agreement of parties as a definite occasion for consideration of the defence problem involved.

Conference of County Agricultural Organisers at Cambridge.

AT the present time a very considerable sum of the taxpayers' money is spent annually on the prosecution of research in many branches of agriculture and agricultural science. It is generally admitted that this research has resulted in many important additions to knowledge which, however, do not find their way into general agricultural practice as quickly as is desirable. It is indeed contended with some justice that the chief defect in our present system is the insufficiency of the connecting links between the research worker and the practical farmer.

On the suggestion of the Directors of the Cambridge University Animal Nutrition Research Institute it has been decided to make an attempt to forge another link by holding in Cambridge during the week beginning on 21st July next a Conference of County Organisers and possibly others interested in the rationing of animals. Each day of the Conference a discussion will be initiated on one of the branches of animal feeding by someone who has carried out research on the subject. It is hoped that the various subjects will be thoroughly debated in the light of recent research work and that the debate may result in arrangements being made for the carrying out of joint demonstrations at several widely scattered centres with the object of testing in practice the views propounded by research workers. It is thought that a Conference conducted in this way may do much to spread the results of recent research in nutrition to live-stock owners through the proper channel—the County Organisers.

The programme of the Conference is not yet complete, but it is hoped that Professor T. B. Wood will introduce the subject of the basis of rationing: that Mr. James Mackintosh, of Reading, will open a discussion on rationing milch cows: that Dr. F. H. A. Marshall, of Cambridge, will speak on causes of sterility in farm animals: that Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, will give an account of his work on the mineral requirements of animals: and that Dr. C. Crowther, of the Harper Adams College, will deal with the feeding of young pigs. Arrangements for the Conference are in the hands of Professor Wood, School of Agriculture, Cambridge, Director of the Animal Nutrition Research Institute.

THE Minister of Agriculture and Fisheries has appointed a Standing Committee to advise as to the administration of any public monies that may be made available for the assistance of Agricultural Co-operation or Credit. The Committee is constituted as follows :—Mr. G. M. Gillett, M.P., The Rt. Hon. F. D. Acland, M.P., Mr. A. W. Ashby, Mr. G. W. Brooks, Alderman Mervyn T. Davies, Sir Basil Mayhew, K.B.E., and Mr. T. H. Ryland. Mr. G. M. Gillett, M.P., has been appointed Chairman and Mr. B. W. Phillips, of the Ministry of Agriculture and Fisheries, Secretary to the Committee.

Committee on Agricultural Co-operation and Credit.

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THE Wart Disease of Potatoes Order of 1923 has now been in force for over twelve months, and while this period is obviously too short to enable any definite opinion to be expressed as to the efficacy of the Order in preventing the spread of the disease, there is every reason to believe that its object has been appreciated generally by potato growers throughout the country, with the result that the requirements of the Order have in most cases been carefully observed.

Movement of Potatoes from Wart Disease Infected Areas.

It appears desirable, however, at this stage to emphasize the particular clause which provides that no potatoes grown in an infected area may be moved or consigned to any place in England and Wales which is not in an infected area. This clause applies to all classes of potatoes whether first or second early and whether intended for seed or for consumption. The only exception is that of ware potatoes of approved immune varieties, and these must be accompanied by a statement to the effect that they are of an approved immune variety and that they were grown in an infected area.

Infringements of this Article of the Order have been known to occur, and in two cases the Ministry has recently instituted legal proceedings which have resulted in the conviction of the defendants, with fines and costs in each case.

The question was recently raised as to whether any exception to this rule could be made in order to allow first early varieties grown in the infected area in South Lancashire to be sent for consumption to large towns in Northern Lancashire and the West Riding of Yorkshire. The matter was referred to the Ministry's Potato Advisory Committee, composed of representatives of all the various branches of the potato industry,

who were unanimous in recommending that no exceptions should be made, and that the Order as it stands should be rigorously enforced.

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Prices and Supplies of Agricultural Produce and Requirements in 1923-1924.

THE Ministry's annual report on the prices and supplies of agricultural produce and requirements is now in the press, and will be issued almost at once.

The report reviews the price movements of the different commodities during 1923 and compares prices over a series of years. This review shows that, although as regards some classes of agricultural produce there were sharp increases and with others appreciable reductions in prices during the past year, on the average the rapid decline which was such a serious feature of 1921 and less markedly of 1922 has in the main given place to a gradual and fluctuating movement, which, though still showing some tendency downward, appears to have lost its momentum. The report compares the increase over pre-war in the prices of agricultural produce with the increases in the case of farmers' requirements, such as feeding stuffs, fertilisers, and seeds, and it is found that, as compared with pre-war, the prices of these commodities have been relatively lower during the past year than those of agricultural produce. Changes in wages since 1914 are also reviewed. The various index numbers of prices of agricultural produce, of agricultural requirements, and of rates of wages, indicate that the farmer during the 7 months September, 1923, to March, 1924, and to some extent during the 18 months ending March, 1924, has had a measure of stability in his industry which compares very favourably with the period 1921-22.

Owing to the change in the statistics of imports and exports which took effect on 1st April, 1923, as a result of the taking over as from that date by the Authorities of the Irish Free State of the administration of the Customs in Southern Ireland, it has not been possible to give in detail a comparison of the home production and imports of the different agricultural products in 1923. The information which is available is given and, wherever possible, comparisons are made with previous years.

The report also contains a review of the position as regards the provision at markets of facilities for the weighing of livestock, and of the extent to which weighing is undertaken.

The report, which forms Part III of the Agricultural Statistics, 1923, is published by H.M. Stationery Office, and may be purchased through any bookseller, price 1s., or direct from H.M.

Stationery Office, Imperial House, Kingsway, London, W.C.2, price 1s. 1d., post free.

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Spraying Potatoes against Blight.

IT has been reported to the Ministry that potato blight has made an early appearance amongst crops, and immediate spraying with Bordeaux or Burgundy mixture is advised. If heavy rain washes the spray from the leaves the operation should be repeated at once. Full directions for spraying are contained in Leaflet No. 23, which can be obtained from the Ministry, 10, Whitehall Place, London, S.W.1.

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Agricultural Index Number.

AFTER falling by 8 points between January and April the index number representing prices of agricultural produce rose by 3 points in May, the general average of prices over the whole month showing an excess of 56 per cent. over those in the corresponding month in the years 1911 to 1913. In May, 1923, prices were 54 per cent. above pre-war; thus the general price level is now slightly higher than a year ago, but the difference between the two years remains very slight.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Both wheat and oats realised higher prices in May than in April, but as a substantial advance was recorded between April and May in the basic years 1911 to 1913, the index number for wheat remains unchanged, while oats, which were only slightly dearer in May than in April, show a fall of 5 points. Barley was slightly cheaper on the month, and the index number for May is 2 points lower than that for April. Barley remains, however, decidedly the dearest of the three main cereals in comparison with pre-war prices.

Potatoes rose sharply between mid-April and mid-May, and although during the latter half of May a fall occurred, the average over the whole of the month, £14 5s. per ton, was £2 15s. per ton higher than in April, while the index number shows a rise of no less than 65 points on the month. In May last year potatoes were making only 72 per cent. of their pre-war value; thus, prices during the past month have been some four and a half times those realised last year.

Hay has again increased in price to a slight extent, and since the normal course of prices at this season is slightly downward, the index number shows an appreciable advance. At the same time, prices are only very slightly above pre-war.

Fat cattle were rather dearer in May than in April, and as the advance was sharper than usually occurs at this season, the index number shows a slight recovery from the decline which had continued without previous interruption since the beginning of the year. Fat sheep are unchanged in price on the month, but the index number shows a substantial advance owing to a fall in the average price between April and May in the basic years. Fat pigs, especially porkers, have again fallen in price, and the index number has declined 3 points on the month.

Store stock prices have followed much the same course as fat stock, cattle and sheep advancing and pigs declining. As more markets are released from the restrictions imposed by the outbreaks of foot-and-mouth disease, the average prices on which the index numbers for store stock are based become more representative of the trade of the whole country, but many markets are still closed and the figures relating to store stock should therefore be accepted with caution.

Poultry shows a further advance, but eggs, although a shade dearer, have risen by less than is usual at this season, and the index number is consequently lower by 8 points.

There was a slight reduction between April and May in the price paid to farmers for milk delivered to some northern and midland towns, and the average over all is now 11¼d.; the index number has fallen correspondingly, May milk prices being 50 per cent. above pre-war. Butter has also fallen considerably, and in spite of a normal seasonal fall, the index number has dropped 11 points, making a total fall of 31 points since February. Cheese, on the other hand, maintains its value, and the monthly average has remained practically unchanged throughout the year up to the present.

Index numbers of different commodities during recent months and in May, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.				
Commodity.	May.	Jan.	Feb.	Mar.	Apr.	May.
Wheat ...	37	34	44	46	38	38
Barley ...	16	34	43	45	48	46
Oats	42	38	41	39	35	30
Fat cattle ...	53	56	54	52	49	51
Fat sheep ...	103	87	75	64	75	87
Fat pigs ..	72	43	34	33	35	32
Dairy cows ...	50	51	48	64	63	58
Store cattle ...	33	35	39	41	38	42
Store sheep ...	98	91	89	85	84	96
Store pigs ...	126	63	50	45	42	36
Eggs... ...	43	85	75	68	48	40
Poultry ...	77	60	52	59	70	87
Milk	63	87	87	71	58	50
Butter ...	40	68	71	63	51	40
Cheese ...	42	76	72	71	71	77
Potatoes ...	—28*	129	170	173	154	219
Hay	41	—1*	—1*	1	0	4

* Decrease.

It is of interest to note that the rise of 3 points this month is due to the abrupt rise in potato prices. Were it not for this rise, the general index number would have been unchanged on the month, or even fractionally lower.

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Conciliation Committees in Agriculture.

THE agreement of the Cumberland and Westmorland Committee, which was due to expire on 7th June, has been extended to 11th November. The terms provide for the payment of skilled male workers at the rate of 37s. for customary hours (about 63 per week), and of other adult male workers at 30s. for a week of 54 hours in summer and 48 in winter.

The Lancashire Committee's agreement has been extended to 31st October. The rates are:—*Southern Area:* Special class workers, 35s. for customary hours; other workers, 32s. 6d. *Northern Area:* Special class workers, 37s. 6d. for customary hours; other workers, 35s. *Eastern Area:* Special class workers, 40s. for customary hours.

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COUNTY AGRICULTURAL COMMITTEES AND AGRICULTURAL DEVELOPMENT.

THE Minister of Agriculture and Fisheries, the Rt. Hon. Noel Buxton, M.P., has had under consideration the question whether the Agricultural Committees of the County Councils might not with advantage play a larger part in the agricultural development of the country than has hitherto been the case.

The Agricultural Committees were established by the Ministry of Agriculture and Fisheries Act, 1919, on the recommendation of Lord Selborne's Committee on Agricultural Policy, to administer the powers of control of cultivation which were contained in the Corn Production Acts and to co-ordinate all the agricultural work for which the County Councils were responsible, such as the provision of small holdings, the local administration of the Diseases of Animals Acts, and, if the County Council so decided, the responsibility for agricultural education. The Committees were also made the constituent bodies for the appointment of a majority of the Councils of Agriculture for England and for Wales.

Soon after the Agricultural Committees were first established an important part of the duties for which they were responsible came to an end by the repeal of the Corn Production Acts, and this has undoubtedly had a detrimental effect on the interests and activities of the Committees, so much so that representations have been made to the Ministry from several counties that in the altered circumstances the Agricultural Committees cannot be of any practical use and should be abolished.

This proposal, however, appears to the Minister to ignore one of the main reasons for the establishment of these Committees in a country which is so predominantly industrial as ours. No means should be neglected which may enlist the interest of the general population in agricultural problems and difficulties; one way of attaining this end is to associate agriculture with the sphere of local government and to set up an authority in each county on which agriculturists, in conjunction with members of other industries, can work together to promote agricultural development in the interests of the whole community. It would have been, and would now be, a great mistake if the recognised organisation of local government did not include a regularly constituted body competent and empowered to speak for agriculture in each county.

That consideration still holds good and justifies the maintenance of the Agricultural Committees. Their abolition would, in the Minister's view, be a retrograde step. The right course is to consider how they can be made of more service both to the industry of agriculture and to the nation as a whole. The fact that the compulsory powers for the control of farming, which were the subject of acute political controversy, have been repealed should make it more rather than less possible for the Committees to do useful work unaffected by party spirit or political bias. The position is that instead of the Committees being the policemen of agriculture, they must rely on the arts of persuasion, education and example.

By these means it appears to the Minister that there is much useful work to be done. The varying conditions in different parts of the country require that the methods to be adopted should also vary, but the Minister hopes that the members of each Committee will regard themselves as collectively and individually responsible for agricultural development in their area, and will consider seriously and systematically what action they can take to promote it.

It is clear that no drastic measures which would arouse acute political controversy are practicable, and accordingly agriculture must aim at the improvement both of men and of methods and the avoidance of waste if success is to be attained. For these purposes education in the broadest sense of the word will be the most effective agent. In counties where agricultural education is controlled by the Agricultural Committee, the task of making the best use of the existing educational facilities and of developing them where possible is one to which the Committees should bend their best efforts. A sound foundation of agricultural education has been established, but much more use might be made of it by all classes of agriculturists. The expenditure on it is therefore much less fruitful than it ought to be. How many farmers avail themselves sufficiently of the practical advice and assistance that they can obtain from the County Agricultural Organiser, from the Horticultural, Dairy or Poultry Officers, or from the Agricultural Colleges or the Advisory Officers attached to them? Again, how small in comparison with the total are the numbers of those who have even once paid a visit to one of the great Research Institutions, and how few there are comparatively who are taking full educational advantage of the valuable schemes for the improvement of livestock. The Ministry endeavours to make known these and other educational

facilities by leaflets and by its *Journal*; but members of Agricultural Committees responsible for agricultural education might well consider whether they could not do more both collectively and individually to spread this knowledge. In particular, members of Agricultural Committees have a special responsibility for the statutory small holders and allotment holders who have been established under the Small Holdings and Allotment Acts. It is specially desirable in their case to see that all possible assistance is given to them by the Organisers and Instructors on the County Agricultural Staff, and it is suggested that the Small Holdings Sub-Committee should give special consideration to this question in consultation with the Committee responsible for agricultural education.

It would be of enormous assistance if every Agricultural Committee would do its utmost (as an official body where it controls agricultural education, as individuals where agricultural education is administered by another Committee) to bring home to every farmer in its county the opportunity and facilities provided through the County Staffs and Agricultural Colleges and the Research Institutions.

Another direction in which the Minister is of opinion that Agricultural Committees can render valuable service is by the promotion and encouragement of sound schemes for the improvement of the facilities for marketing agricultural produce, whether by co-operative organisation, by transport developments, or by other means. The Ministry proposes to appoint a small staff to investigate marketing problems on the lines recommended by the Linlithgow Committee, and it is hoped that their work will be of considerable assistance in determining the directions in which reforms may be accomplished and better organisation secured. It is of the first importance, however, to obtain the co-operation of farmers themselves in attacking these problems, and the Agricultural Committees can do much by ventilating the subject and arousing interest in it.

The Minister believes also that there would be great advantage in a systematic effort to popularise and standardise British agricultural produce. Experience shows that home produce is usually preferred by the industrial population who are prepared in many instances to pay higher prices for British than for imported produce if they can rely upon obtaining it in uniform grades and of first-rate quality. Much might be done in this direction if arrangements could be made for organised bodies of farmers or smallholders to undertake to supply the needs of

organised bodies of consumers, such as the Industrial Co-operative Societies.

The influence of the Committee should also have a considerable effect in raising the general standard of farming and creating a sound public opinion as to the responsibilities which the occupation of land entails. It cannot be denied that there is a growing tendency among certain sections of the industrial population to criticise adversely the manner in which some of the land of the country is being farmed, and the lack of business organisation in the industry. While such criticism is not infrequently ill-formed and made with insufficient recognition of the farmer's difficulties, it is a healthy sign that the towns should take an increasing interest in agricultural problems, and it makes it all the more important that all reasonable grounds for criticism should be removed in order that the danger of hasty or unwise action in the direction of control may be avoided. Committees might therefore undertake a survey of the agricultural conditions of their county, and make it their business to use wherever necessary the powers they possess to deal with injurious weeds under the Schedule to the Corn Production Acts (Repeal) Act, 1921, and also their power to grant on the application of a landlord a certificate under Section 12 of the Agricultural Holdings Act, 1923, in cases where tenants are not cultivating their holdings according to the rules of good husbandry.

On the other hand, it is undeniable that the best farmers in this country are unsurpassed in any part of the world, and it is desirable that publicity should be given to specially successful enterprises of the most progressive and up-to-date farmers in their area. It would be a useful piece of work if the Agricultural Committee—either by themselves or, where necessary, in co-operation with the Education Committee—could arrange with such farmers for periodical visits to their farm, not only by other farmers and smallholders, but also by representatives of urban industries.

Enough has been said to indicate in general terms some of the directions in which the Minister thinks that the Agricultural Committees can play a more active part in rural developments. The important thing in the Minister's view is that the Committees themselves should consider what methods are best adapted to their own localities, and should make suggestions as to the manner in which they can most profitably advance the cause of agricultural development.

The Minister has secured the provision of additional funds which should be sufficient to meet any additional expenses which may be incurred by Committees in the current financial year.

Note.—A circular letter in the above sense was addressed by the Ministry to Local Authorities in England and Wales on 5th June.

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MACHINERY ON THE FARM.

H. G. RICHARDSON, M.A., B.Sc.,
Ministry of Agriculture.

The Coming of the Machine.—At the beginning of the 19th century there was no machinery upon the ordinary farm. The farmer's implements, save in quite exceptional cases, were limited to the plough, harrow, roller, and the hand tools with which he reaped, stacked, thrashed, hedged, ditched and drained. There were innovators who were not content with the traditional equipment and methods of the farm; but new devices were rarely practical. The most marked progress had been in the design of the plough; it was found that the draught could be greatly reduced and great economies effected in horse and human labour, and slowly the modern plough gained general acceptance.

Even with horse and manual labour, however, there is scope for great mechanical development, and horse gears have in the past been used and occasionally still are used for such operations as thrashing, mole draining and raising water: the drill, the reaper, the binder, the swath turner, the hay loader all show what can be performed mechanically with no other power than the horse. But for all that the great advance came, as it did in the manufacturing industry, with the application of steam; even the development of horse-propelled machines is largely due to the stimulus originally given to mechanical invention by steam.

Power.—For heavy work animal power is unsatisfactory. In literature of a century ago may be seen proposals for such implements as draining ploughs which demanded a team of twelve horses; and although mole draining can actually be done and still is performed by horse tackle geared very low, the work is prodigiously slow. Two developments took place side by side: (1) the application to thrashing machines and barn machinery generally of the portable engine (largely superseded later for

thrashing by the traction engine), and (2) the application of cable engines to ploughing, draining and cultivating. With steam engines in these forms, power made a definite appearance on the farm.

The internal combustion engine came later in the 19th century. In the 'nineties the oil engine began to make its way on the farm. At first its uses were limited and it was only employed for such operations as grinding, chaffing, pulping and pumping. Attempts however, were being made to use engines as tractors for cultivation. The Derby Digger was an ambitious attempt to supersede ploughing; but other inventions were based upon an endeavour to find a substitute for the horse. Both steam and internal combustion engines were used for the purpose; such pioneers as the Mann steam tractor and the Ivel and the Saunderson tractors are well known to middle-aged farmers. It was not, however, until the late war period that tractors came into any-like general use in this country. By that time they employed, with extremely few exceptions, an internal combustion engine, and they had reached a comparatively high level of efficiency, although since the designers were influenced by the developments in motor car construction a good deal had still to be learnt before tractors generally became well adapted to field conditions. Implements also required a good deal of modification before they became fitted to the different conditions of tractor draught. Many of the implements at first coupled up with the tractor were found to work unsatisfactorily, due not a little to the employment of implements designed for horse haulage. To many it was something of a discovery that a different motive power demanded different tools, and the coming of the tractor has done more than anything else to stimulate inquiry into the design of agricultural implements.

The popularity of the tractor during the war was due in part to the high price of horses and of their keep. When animals and foodstuffs both fell in price the popularity of the tractor waned. Moreover, the tractor was found by the average farmer to be far less satisfactory than it appeared to be on the demonstration field; it seemed to be subject to frequent breakdowns and to require extensive and expensive repairs. Often these faults may have been in measure due to the tractor, for manufacturers had, as we have suggested, a great deal to learn in the way of design; but much of the trouble was due to the farmer or the farmer's man, who neither understood the tractor nor took any reasonable steps to keep it in running order. Not infrequently

inefficiencies due to faults in the design of tractor implements were put down to the tractor. The horse too was familiar; skilled men could be had for horses, but they had to be sought for the tractor. The tractor to-day is under a cloud.

The Economies of Power.—What then is the use of power in farming? The answer is supplied by the engines which drive the barn machinery and which every one regards with approval. Power enables operations to be performed which, if not otherwise absolutely impossible, could only be performed at the cost of excessive fatigue of animals or men; and it enables these operations to be performed much quicker. These are gains even if the unit cost is the same; they may be gains even if the unit cost is higher. A telegram is more expensive than the post, but it is cheap at the price.

Many farmers have retained a light tractor for harvesting after discarding it for all other operations. In unit cost there is no appreciable gain over the horse in using a tractor to draw a single binder, but the saving of time is undeniable. The tractor moves at a greater speed and works continuously throughout the day up to any hour in the evening, while eight or nine hours or ten at the most of broken time is as much as a horse can reasonably be expected to give. Consequently with the tractor there is a much greater possibility of taking advantage of fine weather. There is a similar advantage in the use of the tractor for ploughing. No farmer needs to be taught that a gain in time makes all the difference in the world in the final return to the farm. That is one aspect of the machine. There is another aspect. Although there may have been no very precise knowledge of the cost and value of such operations as mole-draining and sub-soiling, it has for very long been recognised that they might add very considerably to the fertility of a farm. But except where cable sets were occasionally employed, few farmers of the present generation have mole-drained or sub-soiled, probably because of the strain on the teams and the amount of time consumed. The tractor makes it possible for any farmer who so desires to sub-soil or to mole-drain. The tractor does not work upon so large a scale as the cable-engine, but, so far as can be judged, the work is equally effective, and a pound's worth of tractor work may safely be regarded as equal value to a pound's worth of cable work —indeed it is argued that the small, comparatively shallow, moles that the tractor makes are more effective for the farmer's

purpose, at least in some soils. Be that as it may—for the settlement of such points may be left to scientific investigation by the Oxford Institute of Agricultural Engineering—both tractor and cable engine convey the lesson that power will perform at reasonable cost what horse labour, for all practical purposes, cannot do.

Power is the big man's friend. Even the smallest tractor cannot be used to its utmost value on the small farm; the economies of power are seen on the large scale. The small man must too often work with what are practically the implements of his forefathers; even a new drill is an expensive luxury for a small farmer to own. He needs to be content with a secondhand machine discarded by his bigger neighbour. An expenditure of twenty pounds or so on a swath turner which can be employed only during three or four days in the year is practically prohibitive and economically unjustifiable to the small man who at best wants it for a few hours. The small man may make a living, he may even thrive; left to himself, however, he can get little benefit from machines or from power. But that is not the end of the story: a group of small men may constitute one big man, and may use all the resources of power and mechanism very nearly as well as the big man.

The future of farming lies in the employment of power and machinery, and large scale production inevitably has very great advantages. The tractor enables any farmer with a moderate-sized farm to get nearly all the advantages that power can confer. He obtains the advantages of time saving and the ability to perform heavy operations; except on the stiffest land he is independent of outside contractors, for there are few soils that the tractor will not plough; there is no corn that it will not thrash with a modern thrashing machine. We have said so much of the tractor because it is typical of modern developments in the application of power to the farm. We shall find space to say a little of other forms; but we may as well take the tractor as illustrating other aspects of the problem of machinery on the farm.

Choice and Care.—Half the trouble with machinery arises from buying and using the wrong sort; the other half arises from misuse. When tractors became popular it was not at all unusual for the farmer to buy and couple up unsuitable implements. The selection of implements in the past has usually been largely based upon custom, which, on the whole and with an extremely limited range of types, worked well in eliminating

the obviously unsuitable. The reverse of the picture was seen in the reluctance of many farmers and farm workers to take up new implements and in their inability to form an independent judgment on the merits of a new machine. The ordinary farmer confronted with a new machine was unable to be certain whether it would perform a certain operation under known conditions with a minimum expenditure of power; and if the machine failed he could not, as a rule, say why or where it failed. There has been a general inability to appreciate why a machine is designed in a certain way or the reasons underlying its several parts. It has not been exceptional to find a ploughman discarding removable coulters and getting the smith to weld them in the old fashion; or a farmer stating that a tractor would not subsoil, when the trouble was the employment of a cumbrous ill-designed plough of enormous draught and a sub-soiling tine of gargantuan dimensions.

But the relation of means to the end has been little appreciated in all that concerns farm machinery. An implement that is not selected for the precise work it has to perform can only be right by the merest chance; unfortunately exact knowledge is not easy to attain, and can only be gained by close and continued observation or by scientific investigation. An excellent example of the kind of knowledge that is required is afforded by the investigations into potato-diggers at Leeds, which showed not only the relative advantages of different makes, but what is even more important the advantages of different types embodying different principles. Knowledge of the same kind is required with regard to such implements as the drill, for there is more than mere personal preference in a choice between disc, coulter or duckfoot, between force-feed and cup-feed. Even more important is exact knowledge of the use of the many types of plough; the problem is complicated because there is at present no certain criterion of good ploughing, the relation of ploughing to tilth and to crop being affected by a great many factors, knowledge of which is at present far from complete.

The farmer cannot wait for the accumulation of knowledge. He must make up his mind how he wants a job done, and he must endeavour to secure that the job will be performed as speedily as possible and with the least expenditure of power—human, horse or mechanical. If he judges machinery by these principles and exercises his judgment, while keeping his eyes open for the results of scientific investigations into agricultural machinery, he will not go far wrong in his choice.

Just as important as choice is the care of the machine. Every implement on the farm should be put away after use in such a state that it will be again ready for use whenever it is required. Even such implements as the plough and the cultivator may have their natural life shortened by a half by leaving them in the open. Weather will deteriorate anything made of iron or wood; nor is deterioration the only loss. There are the losses of time and efficiency before the implement is working again properly. A plough with a rusty breast will scour clean, but while it is scouring, power is being lost and the job is being indifferently performed; no great trouble is involved in greasing a plough breast before putting it away. The more complicated the machine the greater the necessity for care; the results of neglecting a plough or a cultivator are not painfully obvious, but neglect of a mower, a binder or a tractor forces itself upon the attention. Too often, certainly in the case of the tractor, the matter settles itself by a general condemnation of inventor, designer and manufacturer, and a hasty scramble to put things right: under such treatment no machine can give reasonable satisfaction. Care when the machine is put away implies care when the machine is running. The simpler implements take care of themselves with a minimum of attention; but the more complicated machines require to be exactly adjusted to their task. Neglected lubrication, a dull set of knives, a wrong adjustment or alignment of the cutter bar will greatly reduce the efficiency of a mowing machine. Errors in lubrication and fuel are the most fruitful sources of trouble with the tractor. And the tractor provides a frequent example of another kind of want of care—demanding of a machine a task beyond its capacity.

The Large Machine.—In conclusion a word may be said of the larger types of machine which no ordinary farmer would own. The largest machines in ordinary use are steam cable sets, for the most part in the hands of contractors and large landowners. On a smaller scale are internal combustion cable sets, and it may be that when in due course electricity is available on every farm cable work will be the normal system. Until that day arrives, the use of the cable system must necessarily be limited, although for a large area of land the great capacity and speed of a cable set as well as the economy in tractive effort—for unlike the tractor the cable engine does not have to propel itself and work at the same time—give it very definite advantages. No comparative data are available, but this seems

obviously to be another instance of the advantage possessed by large scale production in the utilisation of power.

Other machines with which this country has been made more or less familiar are those for cutting trenches for tile draining. In speed and efficiency they are superior to any manual labour, and none but the poorest paid labour could possibly compete in terms of money. The larger machines, such as the "Buckeye," are not farmer's tools: even a large landowner could hardly hope to keep one fully employed. But if field drainage is to be given proper attention in the future, machines such as these in the hands of contractors seem to be the most promising means at hand. Other machines, on the lines of the well-known "Revolt," perform very creditable work in suitable conditions, and this type, which can be propelled by any ordinary tractor, is likely to be so improved in design as to make it more generally successful. On very large areas of land a machine of this type will always be useful, and the price at which it can be manufactured does not make it impossible for the larger farmer to own one. But for the stiffest land and for deep cutting and exact work a heavier and more complicated machine is required; and the machine of the "Buckeye" type is in a class by itself.

Very little agricultural machinery is being bought to-day, and until there is more money in agriculture very little will be bought; but the ultimate success of agriculture will depend more upon the economies of power and the machine than upon any other external aid. Just as in manufacturing industry, the use of power will tend to larger scale production; to bigger economic units; but after all, that is what is really meant by co-operation, the development of which will itself develop the use of power and machinery upon the farm.

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ROTATION OF CROPS.

I.

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MOST of the arable land of Great Britain is cultivated according to some regular and well recognised succession or "rotation" of crops, which experience has shown to be well suited to the local natural conditions and circumstances. In travelling through agricultural districts it is interesting to note how varied are the rotations followed, and to trace the way in

which the variations enable the farmer to take advantage of some special local circumstance or to overcome particular natural difficulties.

While there can be no doubt as to the necessity of having on most farms a fairly definite rotation, it may be pointed out that the existence of a settled plan of cropping on, say, a four, five or six course, makes it difficult for the farmer to adapt his system of farming quickly to altered conditions, and is largely responsible for the traditional view as to the conservative habits of the agriculturist. None the less, it will be found that systems and rotations are continually changing to meet altered circumstances, but such changes are necessarily slow and not always apparent to the casual observer. A farmer is not in the position of a general merchant who can easily concentrate on a new line of goods and drop less profitable ones. He resembles more a self-contained industrial combination which, while searching for and testing new processes and markets, has to keep its existing plant fully employed, and to utilise all its varied raw material.

Object of Rotations.—The following are the chief reasons for growing crops in a regular and definite sequence :—

(1) It enables the land to be kept clean and in constant cropping with the minimum expense.

(2) It provides food in suitable proportions for the stock of the farm, and enables the productivity of the soil to be maintained without excessive expenditure on manures or feeding stuffs.

(3) A well-arranged rotation enables the work of the farm to be well distributed over the year, and provides steady employment for a whole-time staff. By alternating root crops with corn, a considerable saving of labour is effected, as the thorough cultivation given to the former enables the soil to be prepared easily and cheaply for the latter.

(4) While some crops, *e.g.*, wheat and mangolds, can, if necessary, be grown year after year on the same land, others, such as swedes, clover, beans, and to a less extent oats and potatoes, if so grown, are likely to be seriously affected by special diseases and pests. Rotations are therefore arranged so that such crops do not occupy the same ground more frequently than is found by experience to be safe.

(5) Corn crops, following other crops, make use of accumulated fertility and tend to leave the land more weedy than others, while root crops and potatoes are so cultivated and

manured that the fertility of the soil is increased and weeds are reduced. In other cases, as for instance, with clover, beans, peas, etc., the crops actually enrich the soil by the nitrogen taken from the air and left behind in their roots. Therefore, the general frame-work of most modern rotations is an alternation of corn crops with what may be called restorative crops, and as a rule corn crops occupy about half the cultivated area, the remaining half being divided between root crops and clover, or beans and peas. Old leases or agreements frequently contained a stipulation as to the proportion of roots and "seeds," thus preventing an excessive area of what were regarded as exhausting crops. Legislation now exists to give the tenant fairly full freedom of cropping, subject to certain safeguards of the owner's interests, and the proportions given above are frequently varied considerably, but the general arrangement indicated is usually a sound one.

(6) Sheep play a very important part in British farming, and in most districts some of the crops included in the rotation are consumed by sheep on the field in which they are grown. For reasons, which need not be entered into here, sheep, more than any other kind of stock, benefit by change of ground; furthermore, on certain kinds of soils the folding of sheep restores the fertility in a way which hardly any other kind of treatment can do. By having suitable rotations the various fields of the farm are folded in turn, and thus the sheep continually get fresh ground, and at the same time the productivity of all the arable fields on the farm is maintained.

(7) In the absence of a definite rotation it would almost inevitably happen that the fields remote from the farm buildings would be starved, while those conveniently situated near the homestead would receive an undue share of manure and of crops cultivated on restorative lines. It must be admitted that even with a rotation there is frequently a tendency in this direction, but matters would be much worse did not recognised rotations exist.

(8) In a proper rotation one can take advantage of the fact that crops differ in their manurial requirements. The most important manure is farm-yard manure, which supplies all the three important ingredients, nitrogen, phosphates and potash. The crop to which it has been applied may have drawn more on one material than the others, and a suitably arranged rotation enables full use to be made of all the plant food supplied.

Chief Conditions which Determine Rotations and Systems of Farming.—(*a*) *Climate*, including rainfall, temperature—average and extremes—and exposure.

Climate is in many ways the most important condition affecting rotations, and in particular *rainfall* is very often found to be the vital factor. Not only does it determine the character of the arable crops grown, but it affects the proportion of arable and grassland. Where the rainfall is high, as in most western districts, grass predominates, and arable crops are restricted mainly to oats and roots. In the drier eastern areas the proportion of arable land is much greater. Wheat and barley replace oats on many farms, while potatoes and a variety of other special crops are cultivated on a large scale in suitable situations. The following table, based on the 1914 statistics, compares five typical eastern counties with five western counties.

PERCENTAGES OF TOTAL AREA OF ARABLE AND GRASSLAND.

	Arable land (excluding Clover and Rotation Grasses)	Oats.	Other Corn Crops.	Potatoes.
Eastern				
Essex	55.9	7.5	31.8	1.74
Norfolk	58.8	7.1	22.4	1.61
Yorks E.R.	53.6	12.6	23.8	1.71
Berwick	42.8	15.7	11.5	1.57
Forfar	55.3	19.4	15.1	7.39
Western				
Devon	26.3	9.9	7.0	0.85
Pembroke	19.2	8.8	6.2	0.70
Anglesey	18.1	11.6	1.2	1.28
Cumberland	19.8	12.2	0.4	1.40
Wigtown	29.8	19.2	0.4	0.84

In the first group the proportion of the land ploughed in any year is about 50 per cent., while in the western group the average is not much over 20 per cent. It cannot be said that soils and other conditions are exactly similar in the two groups, but there can be no doubt that the great differences between the two sets of figures are mainly the result of differences of rainfall. As illustrating the importance of rainfall in determining agricultural practice, Sir John Russell, in a recent article,* described two soils, one from Anglesey with a rainfall of 35 inches, the other from Suffolk with a rainfall of 23 inches. The former is rated as fairly good agricultural soil used for potatoes and carrots; the latter is waste land of absolutely no

* See this *Journal*, May, 1924, p. 120. "Soil Improvement."

value, although, from the point of view of texture it is slightly better than the former, which contains as much as 93 per cent. of coarse sand. On the other hand, a heavy loam soil might be regarded in a dry district as useful arable land but as unfit for cultivation in a wet area.

Under lowland conditions differences of *temperature* are by no means so important as differences of rainfall, and the effect of temperature on agricultural practice is not nearly so great, except in the case of upland districts. At the same time, the effects of frost, summer heat, and amount of sunshine, are of considerable importance. For instance, mangolds are very rarely grown in Scotland on account of their susceptibility to damage by frost. Similarly, winter oats are not extensively grown north of the Humber. Early potatoes are cultivated in districts where there is known to be little or no danger of damage by spring frosts—*e.g.*, Cornwall, the Ayrshire coast, and other smaller coastal districts. Milling wheat and malting barley require more sunshine, and tolerate greater heat than spring oats, which prefer a cooler as well as a moister climate. The growing of special seed crops on a large scale can only be successfully practised where hot, dry summers enable them to be ripened and harvested in good condition. It is beyond the province of this article to discuss fruit and vegetable crops, but the distribution of these affords an interesting study in the effect of climate as well as soil on practice.

Reference may perhaps be made to the effect of *exposure* and liability to damage by gales. This is of vital importance in fruit culture, and even with ordinary farm crops a gale about harvest time may easily cause very serious damage to corn and potatoes, and this helps to restrict the area of such crops in bleak situations. It need hardly be said that the effects of climate are not confined to the direct effect on the growth of the crops themselves. The risk of damage by unfavourable conditions—particularly rain or frost—before the crop can be safely harvested is an important consideration, and the earliness of harvesting and the customary time of sowing, both dependent on climate, directly affect the rotation. Where corn harvest is early and seed time for roots late, as in the south of England, there is an opportunity of cultivating catch crops, as is done in the Wiltshire and other rotations practised in the south of England.

(*b*) *Soil*, including general character, depth, fertility, slope, drainage, etc.

Even where the climate is suited to arable cultivation, soils, such as heavy clays and steep stony slopes, which can only be cultivated at great expense, tend to be laid down to grass, or at any rate to be cropped on a rotation including a temporary grass ley. Similarly, low-lying fields, or badly drained soils, are left in grass. Leaving out of account, however, such extreme cases, the various classes of soil are naturally suited to different crops. Such descriptions as "wheat and bean land," "good sheep and barley soil," convey more meaning to the farmer than a lengthy detailed description of the soil itself would do. Generally speaking, wheat, beans and bare fallow, with some mangolds, cabbages and red clover are characteristic of the clay soils. Potatoes, carrots and rye are the best crops for practically pure sands. Barley, swedes and turnips do best on fairly dry soils of medium texture. Oats flourish in soils containing a good deal of organic matter, and are the best of the corn crops for peat. Vetches, peas and leguminous crops, with the exception of beans, are cultivated most extensively on chalky soils.

(c) *Accessibility and Facilities for Marketing Produce.*

This perhaps needs little comment, as it will be generally realised that a farmer who lives several miles from a station will naturally wish his produce to "walk to market." On the whole, in this country, accessibility is not so important a factor in determining the crops grown as suitability of soil and climate. If the latter are particularly fitted to a certain crop for which there is somewhere a good demand, transport difficulties will somehow be overcome. For instance, the Fen district is remote from big centres of population, but none the less it is one of the chief areas from which the potato supply of large towns throughout the south and midlands of England is drawn. Similarly a large raspberry growing industry has been developed in rather remote districts of Perthshire, while the London milk supply is drawn from a very wide area, including the south, west and north-west of England.

(d) *Labour.*—The securing of sufficient or properly skilled labour often presents great difficulties when it is desired to adopt new systems, or to raise crops requiring special skill in handling, but it is rarely found that this is a permanent obstacle, except where it is desired to introduce in a thinly populated remote district some crop or method which demands a large supply of experienced labour for a short period only.

(e) *Fluctuations in market prices* affect the proportion of crops grown from year to year, though the majority of farmers

wisely make such changes very cautiously, as they have to plan for some years ahead, and it by no means follows that a specially high price for one kind of farm produce will be obtainable for two or more years in succession. Notorious examples of this uncertainty are peas and potatoes.

(*f*) *Other circumstances* of a more specialised character often have some effect. For instance, the existence of a hill grazing may make it necessary to devote the lowland cultivated area almost exclusively to the growth of winter food for the hill stock. The size of fields, nature of fences, water supply, etc., determine to a great extent whether temporary leys for grazing can be adopted. The presence of game, birds, rabbits, etc., may make it desirable to reduce the area of corn. On the other hand, the farmer himself may have a special liking for certain crops or systems of farming, which do not appeal to his neighbours.

In the long run, however, climate, soil, markets, and prices are the main factors which determine the rotation followed, though other influences may result in temporary deviations from the general rule. At the same time, changing conditions, particularly those of prices and markets, make it necessary to introduce changes in cropping, and there is need for more rapid adjustment than commonly exists. Such need is, for instance, often clearly seen where local farmers in a remote district have failed to realise the possibilities opened up by the inrush of a large population as the result of the establishment of large works, or the development of a seaside summer resort. A farmer coming to a new district usually sees ways in which greater efficiency and better results can be obtained, though, if he is wise, he will wait until he has gained a fairly thorough knowledge of local conditions before attempting to introduce crops and methods totally new to the district. The value of fresh blood and new methods can be seen in many parts of the country, but it will generally be found that the most successful innovators have proceeded at first with a great deal of caution, and have made it their business to understand thoroughly the old methods before departing far from them.

(To be concluded.)

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THE PHYTOPATHOLOGICAL SERVICE OF ENGLAND AND WALES.

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IN most of the civilised countries of the world there now exist more or less completely organised services, under Government auspices, for dealing with the diseases and pests of cultivated plants and crops. Such phytopathological services vary to some extent in character and mode of operation in the different countries, and a summarised account of those then existing was published by the International Institute of Agriculture in Rome ten years ago.* Since that time, so far as England and Wales are concerned, there have been considerable developments, and the account given in that publication no longer reflects accurately the condition of affairs.

The present time, when visitors from all parts of the Empire, many of whom have interests in agriculture and horticulture, are coming to this country for the purpose of seeing the British Empire Exhibition, seems to be opportune for presenting a fresh survey of the present state of our official phytopathological activities, and this article is intended to present a résumé of the various phases of work carried out directly or indirectly by the Government with the object of controlling the damage caused by plant pests and diseases in England and Wales.

These activities cover many fields of work. They deal with the primary function of identifying organisms which cause damage to crops, with fundamental research on entomological and mycological problems, with investigations as to the means of control which can be adopted in practice, and also with the formulation and administration of Acts and Orders designed to prevent the introduction of pests and diseases from abroad and to restrict the spread of those which are indigenous or established here.

Origin and Development of the Service.—Whilst there is no need to trace the development of the service in any considerable detail, nevertheless, the present state of affairs will be more easily understood if some account of its origin be given. About the year 1877 the country became seriously alarmed at the possibility of the introduction of the Colorado Potato Beetle into

* "Le Service de Protection des Plantes dans les divers Pays." IIe Edition. Rome. Imprimerie de l'Institut International d'Agriculture, 1914.

Britain—an alarm which was intensified by the knowledge of the disastrous results which had occurred on the European continent consequent on the appearance of the American Vine Phylloxera a good many years earlier. As a result, the Privy Council was empowered by Parliament to issue such Orders as were necessary both to keep out the Colorado Beetle and to deal effectively with incipient colonies of this pest should any make their appearance. No special staff of inspectors or other officers was created for the purposes of the Act,* but its administration was left to the ordinary civil authorities of the country. In 1889 the powers of the Privy Council in regard to this Act were transferred to the Board of Agriculture, but this appears to have brought about little or no change from the standpoint of phytopathology.

The next landmark is the Act of 1907† which enlarged the Board's powers and enabled it to deal not solely with the Colorado Beetle but also with all insects, fungi and other pests which may attack any crops, trees and bushes. This Act, like its predecessor, also appears to have had its origin in a wave of alarm, caused on this occasion partly by the discovery of the presence in Britain of the very serious American Gooseberry Mildew, from which the country had hitherto been absolutely free, and partly by fear of the possible introduction of the San José Scale insect which was doing so much damage to fruit trees in the United States.

Research and Advisory Work.—At this point it is necessary to digress a little from legal and administrative matters and to go back a year or two in order to trace the beginnings of a definite system of research and advisory (extension) work in connection with plant pests and diseases. Apart from Sir Charles Whitehead, who devoted much time to insect pests when Chief Scientific Adviser to the Agricultural Department of the Privy Council (and later to the Board of Agriculture), there was no whole-time entomologist or mycologist on the staff of the Privy Council or the Board. Noteworthy during the period, however, are the names of Mr. F. V. Theobald, Dr. R. Stewart MacDougall (entomologists), and the late Mr. G. Massee, of Kew (mycologist), who acted either directly or through their Departments as advisers to the Board. Special mention must also be made of Miss Ormerod, who, as Consulting Entomologist to the Royal

* "An Act for preventing the introduction and spreading of Insects destructive to Crops." 40 and 41 Vict., Ch. 68. 14th August, 1877.

† "An Act to extend the Destructive Insects Act, 1877, to all Pests destructive to Crops, Trees and Bushes." 7 Edw. VII, Ch. 4. 4th July, 1907.

Agricultural Society, followed John Curtis as a pioneer in economic entomology in England. These scientific workers all did magnificent work on behalf of agriculture and horticulture, but they cannot be claimed as having been members of any official phytopathological service.

In 1909 and 1910 considerable progress was made as a result of the passing of the Development and Road Improvement Funds Act, 1909, which *inter alia*, provided resources for a definite scheme of research, investigation and advisory work in agricultural and horticultural plant pathology. Without exceeding the limits of the present article, it would be impossible to give any comprehensive account of the developments which have been possible through the agency of this Act, but it may be stated that, as a matter of policy, it was decided that the funds rendered available should be expended in the main (*a*) on subsidising existing scientific institutions in order to enable them to undertake research in one or more of the component subjects of agricultural science; and (*b*) on the subsidising of the same or other similar institutions in order to develop local investigation and advisory work within definite areas or "provinces:" Under this scheme scientific workers were, therefore, attached to the staffs of research or teaching institutions (universities and agricultural colleges), and they became ordinary members of such staffs and not Government officials.

So far as fundamental research is concerned, two institutes were at first created to deal with plant pests and diseases, viz., one of Agricultural Entomology at Manchester University and one of Plant Pathology at the Royal Botanic Gardens, Kew.* A third institute, dealing with Agricultural Helminthology, was also established at Birmingham University. As regards local investigation and advisory work, the colleges and institutions concerned were left practically free to appoint specialists in those branches of agricultural science in which it was considered the existing staffs required strengthening. From the outset, however, there was a tendency to appoint entomologists and mycologists, partly because these subjects were not already well represented, but perhaps chiefly because applications received from farmers and fruit growers for advice were so frequently concerned with phytopathological questions.

In consequence of the passing of the Destructive Insects and Pests Act, 1907, and while the organisation under the Development Fund was taking shape (1909-1914), a significant move had

* These two institutions have now been combined and transferred to the Rothamsted Experimental Station.

been made by the Board of Agriculture in the creation of a staff of inspectors specially set apart for the administration of the Acts dealing with plant pests, and also in the appointment of an entomologist as a permanent member of the headquarters staff of the Board. The local authorities also appointed inspectors to administer the Orders issued by the Board under the Acts, but in 1914 the entire administration of the Orders was taken over by the Board.

Immediately before the outbreak of the War in 1914, therefore, there were two organisations engaged, or destined to be engaged, in the fight against plant pests and diseases—a small body of Government officials under the Board of Agriculture, whose main duties were to administer the Destructive Insects and Pests Acts, and another body of scientific workers paid from Government funds, but not Government officials, who were appointed to conduct research, investigation and advisory work throughout the country. The existing phytopathological service, which may be taken as including both organisations, thus had a dual origin, and this has resulted in its separate parts remaining, from the administrative point of view, distinct.

At this point, however, the historical aspect of affairs may be left, since the nucleus of the present service has now been traced and subsequent developments have consisted essentially in natural growth along already settled lines.

Subsequent Development and Present Position.—The four years of the War, succeeded by the difficult period of post-war reconstruction, naturally impeded the growth of the phytopathological service to some extent, but in spite of fluctuations and changes in personnel, the scheme worked out by 1914 has persisted and has governed all subsequent development. The Service to-day, therefore, still consists of two main sections* :—

A.—The official section attached to and controlled directly by the Ministry of Agriculture (previously the Board of Agriculture).

B.—The non-official section distributed through the various Universities, Agricultural Colleges and Research Institutes of the country, financial provision for which comes from Government funds, but which is free from the detailed instructions of the Ministry, and subject only to a certain amount of supervision to ensure efficiency.

* The pests and diseases of forest trees for timber production are dealt with by the Forestry Commission, an organisation not described in the present article.

Each of these sections is sub-divided into certain definite units, and before attempting to explain how the whole field of work is thus covered, it may be well to indicate the composition of these units.

(a) *Official Section.*—This is divided into three units :—

(1) The Pathological Laboratory at Harpenden, which has a small entomological and mycological staff;

(2) An administrative unit, forming an integral part of the Horticulture Division of the Ministry in London;

(3) The Ministry's Inspectorate, about 30 members of which have special qualifications in regard to plant pests and diseases, although these officers are not exclusively employed on such matters.

(b) *The Non-Official Side.*—This consists of :—

(1) The Phytopathological Research Institute attached to the Rothamsted Experimental Station at Harpenden, and also scientific workers attached to such specialised research stations as the Long Ashton Fruit Station, Bristol; the Imperial College of Science, London; the Fruit Station at East Malling; the Lea Valley Station, Cheshunt (Glasshouse crops); and the Department of Helminthology of the London School of Tropical Medicine;

(2) The corps of advisers, consisting of an entomologist and mycologist in each agricultural province, fourteen in number.

The Government grants in aid of the work detailed under (b) (1) and (2) above are administered by the Research Branch of the Ministry of Agriculture.

At the end of this paper further details will be found as to the present personnel of the service, the areas covered by the various advisers, etc., but in order to understand the general working of the system, the above information will probably prove sufficient. In dealing with this aspect of the subject, however, some indication of the field that has to be covered must be given. In the practical control of any plant pest or disease the following stages have to be dealt with by one working unit or other, viz., diagnosis, research on fundamentals, investigation and trial of probable practical measures of control, and the rendering of the last-named available to the industry. In addition there must be some general intelligence system to record both the geographical distribution of pests and diseases and also their relative importance. Finally, legislation must be administered in order to check the introduction of pests and diseases, and, under certain conditions, to curtail the spread of such as are already present in the country.

This field of work is divided among the different parts of the service approximately as follows :—

The advisers diagnose troubles on behalf of the farmers and growers within their respective provinces. They carry out experiments on the practical control of pests of local importance and render the results of their work available to the industry, being assisted in this by members of the county educational staff, such as the county agricultural organisers and the horticultural superintendents*—who might, indeed, quite properly be regarded as having a definite place in the Phytopathological Service.

Research into fundamentals—*e.g.*, the physiological action of insecticides, the nature of immunity and resistance to disease, etc., etc., is carried out by the scientific workers stationed at the Research Institutes at Rothamsted, East Malling, Long Ashton, Lea Valley, the Imperial College of Science and elsewhere.

The Ministry's Pathological Laboratory at Harpenden has as its main function the provision of a scientific basis for the Orders issued under the Destructive Insects and Pests Acts and for all other special work required in connection with legislation of this type. It is also in charge of the intelligence system, that is the collection and distribution of information in regard to the spread and depredations of pests and diseases. Apart from this, however, this laboratory is at present very largely the "maid of all work" of the service, sharing to some extent both in investigation and advisory work, the former usually in co-operation with workers in other branches and the latter by such means as the preparation of leaflets and exhibits at shows. Finally, it has obviously to act as the co-ordinating centre for the whole service.

The practical work of administering existing legislation with regard to pests and disease, is carried out in the field by the inspectorate, and at headquarters by the Horticulture Division of the Ministry. These two groups also carry out, in co-operation with the laboratory at Harpenden, the very extensive work required in the necessary inspection and issue of certificates of health for consignments of plants going abroad. In the same way the control of plants imported into the country is provided for.

Each part of the service has its own sphere of operations in which it carries out its own independent routine work, but at

* These officers are employed and controlled by the various County Councils, the cost being borne in part by the county and in part by the Ministry of Agriculture.

the same time co-operation is continuous between the various branches of the service in dealing with both large and small problems. As important as, or second only in importance to such co-operation is similar co-operation between the officers representing the various sciences, since not only can an entomologist when in difficulty consult a mycologist, but also in practically every institute or station chemists, physicists and other specialists are available who can be, and indeed are, drawn into the net of the phytopathological service when required. It is thus possible to avoid one danger which may threaten a scientific service, viz., that of working in a watertight compartment.

The field of work is thus covered by a service which, though not under unified control and in consequence rather loose in its organisation, yet nevertheless works as a whole, and should prove capable of developing in future in any direction which circumstances may prove necessary. It must not be thought, however, that an official phytopathological service can provide all that the country requires—any more than the veterinary section of the Ministry and the various departments engaged in veterinary research can do all that is needed in connection with diseases of animals.

Plant diseases and pests cause losses comparable with those which result from animal pests and diseases, and similarly they require not only an official service but also a profession of workers like the veterinary profession. Even at present there are signs of the development of such a profession in the appointment of entomologists and mycologists by agricultural firms to investigate special problems. Further development along these lines may be expected in any branch of the industry in which the capital per acre involved is large and the profit in proportion, and also in cases where very large acreages are in the hands of single persons or firms. A considerable increase in the number of private practitioners, however, can scarcely be expected under present-day economic conditions, and it is probable that for many years to come the greater part of the work of pest and disease control will have to be carried on by the official service.

The role of a prophet is, admittedly, a dangerous one, but in concluding these notes it may not be injudicious to take a little risk and look to the possible future of the service. The development of the research institutes appears likely to proceed without much fundamental change either in their work or in their posi-

tion in the general scheme. The advisers, however, may in due time perhaps prove to have filled a stage in evolution rather than to have become a permanent institution. At present the range of knowledge required in an adviser is somewhat encyclopædic, and just as the old-time naturalist has been succeeded by the more specialised biologist of to-day, so it seems likely that the adviser may need to restrict his scope in certain directions, if he is to become and remain efficient in any. As the county councils' educational staffs develop they may prove able to take over more and more of the advisory side of the adviser's work, freeing the advisers themselves to an increasing degree for investigation—probably on certain defined ranges of crops. The adviser's field of work will perhaps not be determined so much by geographical or political boundaries as by the location of the particular type of crop on the diseases of which he has specialised, and such areas will be determined largely by the climatic and soil factors which operate in crop production. He will then be in a position not only to be expert in his own science, but also to be familiar with every aspect and detail of the cultivation of the particular crop or crops, the pests or diseases of which he investigates—a knowledge which is essential if really practical results are to be obtained.

With the purely official side of the service, it would not be proper for the writers of this article to deal—even in the rôle of prophets. It may, however, quite safely be anticipated that with the developments in communication between one part of the world and another, the problem of the introduction of foreign pests and diseases must become one of increasing importance; that Governments will more frequently be confronted with epidemics of diseases, comparable to the American Gooseberry Mildew in England and pests such as the Gipsy Moth in the U.S.A., than in the past, and that in consequence more work will be thrown upon the official section of the service. The task of workers in this section will be greatly lightened if the present tendency for co-operation between the official services of all countries should increase, since in this way it may be possible to deal with the problem not only by mere restrictions but also by developing nature's own methods of controlling pests and diseases before they have time to become epidemic.

Ministry of Agriculture and Fisheries.

Pathological Laboratory, Harpenden.	J. C. F. Fryer, Director (Entomologist). G. H. Pethybridge, Mycologist. R. Stenton, Assistant Entomologist. (Vacant) Assistant Mycologist.

Research Institutes at which Phytopathological work is undertaken.

1. Rothamsted Experimental Station, Harpenden.	A. D. Imms, J. Davidson, H. M. Morris, D. M. T. Morland, Entomologists. W. B. Brierley, J. Henderson Smith, Miss M. D. Glynne, Mycologists. Mrs. B. M. Roach, Algologist.
2. Imperial College of Science, South Kensington, London.	
3. University of Bristol Agricultural and Horticultural Research Station, Long Ashton, Bristol.	A. H. Lees, Entomologist. H. Britton-Jones, Mycologist.
4. East Malling Fruit Station.	H. Wormald, Mycologist.
5. Lee Valley Research Station.	W. Bewley, Mycologist (Director). C. R. Speyer, Entomologist.
London School of Tropical Medicine (Department of Helminthology).	(Vacant) Helminthologist.

List of Advisory Centres, Counties served and Advisers in Entomology and Mycology.

1. Armstrong College, Newcastle-on-Tyne.	Northumberland. Durham. Cumberland. Westmorland.
R. A. Harper Gray, Entomologist.	F. E. Smith, Mycologist.
2. Leeds University	Yorkshire.
T. H. Taylor, Entomologist.	W. A. Millard, Mycologist.
3. Midland College, Sutton Bonington, Loughborough, Leicester.	Lindsey, Lincs. Nottinghamshire. Derbyshire. Leicestershire. Rutland.
A. Roebuck, Entomologist.	H. H. Stirrup, Mycologist.
Cambridge University.	Holland and Kesteven, Lincs. Soke of Peterborough. Isle of Ely. Norfolk. Huntingdonshire. Bedfordshire. Cambridgeshire. Suffolk. Essex. Hertfordshire.
F. R. Petherbridge, Plant Pathologist.	W. A. R. Dillon-Weston, Assistant.

5. S.E. Agricultural College, Wye, Kent.	London. Kent. Surrey. Sussex.
F. V. Theobald, Entomologist.	E. S. Salmon, Mycologist.
6. University College, Reading.	Buckinghamshire. Middlesex. Berkshire. Hampshire and Isle of Wight. Dorset.
F. O. Mosley, Entomologist.	W. Buddin, Mycologist.
7. Oxford University.	Northamptonshire.* Oxfordshire.
N. Cunliffe, Entomologist.	R. Woodward, Mycologist
8. Seale Hayne College, Newton Abbot.	Devonshire. Cornwall.
W. E. H. Hodson, Entomologist.	A. Beaumont, Mycologist.
9. Bristol University.	Herefordshire. Worcestershire. Gloucestershire. Wiltshire. Somerset.
L. N. Staniland, Entomologist.	R. Nattrass, Mycologist.
10. Harper Adams College, Newport, Salop.	Shropshire. Staffordshire. Warwickshire.
S. G. Jary, Entomologist.	N. Preston, Mycologist.
11. Manchester University.	Lancashire. Cheshire.
K. M. Smith, Entomologist.	E. Holmes Smith, Mycologist.
12. University College of Wales, Aberystwyth.	Merioneth. Montgomery. Cardigan. Radnor. Brecknock. Carmarthen. Pembroke.
J. R. W. Jenkins, Entomologist.	D. W. Davies, Mycologist.
13. University College of S. Wales and Monmouth, Cardiff.	Glamorgan. Monmouth.
H. W. Thompson, Entomologist.	J. Rees, Mycologist.
14. University College of N. Wales, Bangor.	Anglesey. Carnarvon. Denbigh. Flint.
C. L. Walton, Entomologist.	T. Whitehead, Mycologist.

* The inclusion of Northamptonshire with the Oxford province is at present under consideration.

DAIRY FARM BUILDINGS, FITTINGS AND EQUIPMENT: THEIR RELATION TO CLEAN MILK PRODUCTION.

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National Institute for Research in Dairying, Reading.

THE success which has attended the clean milk competitions promoted by county and other authorities and supported by the Ministry of Agriculture, has resulted in an increasing appreciation amongst dairy farmers of the necessity for more hygienic methods in the production and handling of milk at the farm.

It has been shown conclusively that success in clean milk production rests largely upon the quality of the labour employed and the method practised. These, however, are not the only considerations, since it is certain that good buildings and well-chosen equipment render material assistance in the production of milk of the highest purity. Dark, ill-ventilated and insanitary cowsheds, for instance, are largely responsible for the spread of respiratory and udder diseases amongst housed cattle, which are deprived of the known benefits of fresh air and sunlight in destroying disease-producing and other organisms. The proper housing of the animals is of particular importance in those districts where climatic conditions compel stall feeding for many months of the year. Further, the amount of time and labour which must be expended in keeping the buildings and cattle clean is very largely reduced in well-designed and equipped byres.

Not the least point of importance is the psychological effect upon the workers who, serving under insanitary conditions, can hardly be expected to give of their best.

The great majority of dairy farmers and landlords will be concerned not with the erection of entirely new buildings, but with the improvement of those which exist. This article is, therefore, designed to apply chiefly to the latter.

The Cowshed: *Ventilation.*—It becomes abundantly evident in making inspections of existing cowsheds that ventilation has not in the past been a prime consideration in their construction. There is still a widespread prejudice in favour of a system, or lack of system, of ventilation, which allows the farmer to keep his cows "warm." Although it is certainly very undesirable that cows shall be exposed to draughts, the prevalent idea that

the milk yield of the animals is increased in proportion to increases in temperature has been shown to be a fallacy.

Elaborate systems of ventilation which depend for their efficiency upon constant adjustments of inlets and outlets are hardly likely to be successful. Efficient ventilation can be secured by the correct disposal of windows of the right type, which also serve to admit the light which is so necessary and so often absent. Those windows which are hinged at the bottom and open inwards are desirable, since they supply abundant fresh air and do not allow draughts to reach the cows. The old system of air bricks under the eaves is excellent. The raising of the ridge tiles at intervals provides an effective outlet for foul air in the absence of an extraction cowl.

Although the American system of housing stock and all the fodder under one roof does not recommend itself to English practice, many cowsheds have a loft above. In these cases it is often necessary to provide an air shaft with an extraction cowl to the apex of the roof.

Air Space.—It is not possible to dismiss the question of ventilation without a reference to air space. In spite of the fact that an efficient ventilating system can be made to remedy defects of air space, it is desirable that in making alterations to cowsheds every endeavour should be made to approach the minimum of 600 cubic feet per cow for large animals and 500 cubic feet for small ones. In considering air space the question of floor area is important, since height above 14 ft. is of little use. It is often wise when making internal alterations to sacrifice the use of an existing stall to considerations of air space.

Light.—Abundant light is essential and cannot be too freely provided. The position of windows should be so arranged that plenty of light falls on the hindquarters of the cows. The construction of the walls behind the cows sometimes restricts the amount of window space, and in these cases, when there is no loft above, existing tiles may be replaced by patches of Bridgwater glass tiles. Every effort should be made to provide at least three square feet of window space per cow.

Artificial Light.—The great majority of farms have not the advantage of a public lighting service, and the provision of good artificial light has been a matter of some difficulty. The old type of hurricane lamp is not adequate and requires constant attention. Incandescent petrol vapour lamps, which are economical and give ample light, are now specially made for use on farms.

Floors, Walls and Roofs.—In making interior alterations to the cowshed, the question of ease in cleaning must be kept in mind. Unnecessary angles and corners should be avoided and smooth, plain surfaces aimed at. The use of cement concrete has solved this difficulty on a large number of farms. It is relatively cheap, easily laid and durable. Practically any existing floor may be greatly improved by laying concrete to a depth of 6 to 7 in.

The practical farmer will probably question the wisdom of the use of concrete for cow stalls, on the ground that it is cold, and liable to cause udder chills. The objection is, however, not borne out in practice, since the amount of udder trouble on the large number of farms where concrete has been used and where clean milking is practised is undoubtedly less than under ordinary circumstances.

Walls.—Rough stone or brick walls can also be covered with a thin layer of cement, which greatly facilitates cleaning and prevents the accumulation of dust. Even wooden walls can be faced on the inside with cement to a height of about 4 ft. 6 in. The remainder of the walls as well as the roof can be kept in a sanitary condition by the frequent use of the lime wash spray. This latter is a cheap and effective way of disinfecting and keeping the sheds clean, and its use should be encouraged to the fullest extent.

Standings.—The dimensions and fittings of the standings are amongst the things which have the most important and direct bearing on the quality of the milk produced, and much unnecessary expenditure has resulted from failure to grasp the fact that raised standings are provided solely for the purpose of keeping the cows clean. In order that this may be done, the length of the standing from the edge of the manger to the edge of the gutter must not be more than 5 ft. or 5 ft. 6 in. for large cows like Shorthorns and Friesians and 4 ft. 6 in. or 5 ft. 3 in. for smaller cows like Jerseys, depending in each case on the types of neck fastening adopted.

That the comfort of the animals may not be sacrificed in a space apparently so short, it is essential that the manger shall be of the right construction. The height in front must not be greater than 12 in., and the width neither less than 2 ft. 6 in. nor more than 3 ft. The former width is necessary in order that the cow may rest her head on the manger, but it must obviously not be so great as to allow the cow to step forward and so foul the standing. In sheds where there is a double row

of cows head to head, or where there is a feeding passage, it is often necessary and important to provide a rail behind the mangers to keep the cows back. Existing mangers may usually be made to conform to this plan by dropping them to the floor level. Glazed half-pipes make very good mangers when set in concrete.

When making new mangers it is important to provide drainage for flushing them at intervals with water. Mangers may be made in concrete for each cow separately, or one long manger may be provided with special galvanised iron partitions, which can be swung out of the way when cleaning.

Height of Standings.—Much of the usefulness of raised standings is lost unless they are sufficiently high, and 10 in. should be regarded as a minimum from the bottom of the dung channel to the level of the standing. Any less depth of gutter than this is very liable to prove inadequate for keeping the cows free from their excreta. There should always be a fall of about 1 in. from the manger to the gutter. The smooth surface of the standing should be provided with shallow herringbone grooves which encourage drainage and give a foothold for the cows.

Width of Gutter.—The depth of the gutter in front must be 10 in. and 4 in. at the back, so that splashes may be arrested. To carry off the liquid part of the excreta the writer considers that a groove should be provided at the shallow side to which there should be a slight fall from the deeper side.

No gutter should be less than 18 in. wide and 24 in. is preferable. This width allows of the free use of brush and shovel in cleaning and encourages cows to step into it instead of attempting to step over, at the risk of slipping on the edge of the standing.

Total Length of the Stall.—The total length of each stall works out at from 7 ft. 6 in. to 8 ft., from the back of the manger to the edge of the gutter. Any attempt to lengthen the standings to more than 5 ft. 6 in., must result in failure to keep the cows clean. Width of manger, on which the cow's comfort so largely depends, should not be sacrificed to the width of the passages behind or in front of the cow.

Partitions.—Where space permits it is better that cows should stand separately rather than in pairs or in one unbroken row. In double stalls one animal is very liable to foul the bed of the other, and injuries to the udder are not infrequently caused by one cow treading on its neighbour. Wooden partitions are not desirable, and may be replaced economically by modern sanitary tubular fittings; these are durable and relatively inexpensive.

Methods of Tethering.—It is a matter of some difficulty so to tether the cows that they have sufficient freedom for comfort and yet are prevented from stepping forwards and fouling the standing, or backwards, and slipping into the gutter.

Perhaps the most effective method is the use of the galvanised iron stanchions lined with wood, which are supplied by English and Canadian firms. These give relative freedom of movement but do not allow the cows to step backwards or forwards. They have the additional advantage of being easily opened and closed, so that the time lost in securing the cows for milking is reduced to a minimum. Further, some types can be so adjusted that a stall of standard length can be made to accommodate cows of different lengths. This alignment device is very useful with a herd of cattle of different sizes.

Water Supply, Drainage and Disposal of Manure.—An abundant supply of water laid on to the cowsheds is both an advantage and a necessity, since a considerable quantity of water is needed for washing the sheds and the cows.

A tank for liquid manure would be a valuable addition to many dairy farms, and in order that this valuable fertiliser may not be unduly diluted with the water used for washing, an arrangement should be made to divert the highly diluted washings to the general drainage system. This may be effected by a two-way sluice which can be opened or closed as the occasion demands. The liquid manure tank and manure clamp should be at a reasonable distance from the cowshed.

Much time and labour can be saved in cleaning out and feeding by the fitting of carriers running on an overhead rail from the cowshed to the fodder store and manure clamp.

Cows' Drinking Water.—An abundant supply of drinking water, which is available at all times, is of material advantage. Cows in milk require large quantities of water, and it is obviously better that they should be able to drink when they want to do so rather than wait for a fixed hour of watering. A separate small trough for each cow is the ideal arrangement, as the danger of the spread of colds, etc., from cow to cow by water is eliminated. Such troughs are made as standard fittings by firms which specialise in cowshed fittings.

If this arrangement is not possible a concrete trough, running the length of the shed and immediately behind the mangers, may be installed. An outlet to permit of regular cleaning should be provided.

Washing of Hands.—Facilities for the washing of the milker's hands before the milking of each cow must be provided. All that is really necessary is a tap, a pail of water, soap and clean towel. A hand basin near the milk tip is an admirable arrangement as each milker can then wash his hands before returning to milk the next cow.

Equipment Used for Milking.—The washing of the cows is made very much easier if the hair on the flanks and udders is kept short. An ordinary pair of hand clippers should, therefore, form a part of the equipment of every dairy farm.

Milking Pails.—Because of the great reduction in the amount of visible dirt which is found in milk taken into covered or domed pails, these are coming into much more general use. There are many types of such pails on the market, but the essential feature is a small opening measuring about 7 in. by 5 in., which is set as nearly vertical as is practicable. Every part of the interior of the pail must be readily accessible for cleaning, and those pails which are free from seams and crevices should be chosen. In order to facilitate cleaning some types of pail have the domed top detachable. All covered pails may be tared to act as weighing pails by adding lumps of solder to the bottom; this procedure avoids the necessity of pouring milk from the milking to the weighing pail.

Milking Stools.—The usual type of wooden milking stool requires constant attention if it is to be kept clean, and is liable to split if sterilised by steam. These may now be replaced by an aluminium stool which is easily cleaned and may be safely sterilised by steam.

The Milk Room.—In view of the benefits of refrigeration in prolonging the keeping qualities of milk all modern dairy farms are now equipped with facilities for cooling the milk. This should be carried out in a small building reserved solely for the purpose. Unless it can be separated from the cowshed by a sound wall the milk room should not be under the same roof as the cowshed. Nevertheless, it should not be at such a distance from the cowshed or milking shed as to constitute a tax on time and labour in carrying the milk. Care should be taken to avoid any position which is exposed to such sources of dust as the stack yard or food cutting and mixing barns.

There is the same necessity for ample light and ventilation in the milk room as in the cowshed, and at least one window should give a good view of the cooler without the necessity for entering the room.

Floor and Walls.—The floors and walls must both be constructed of material such as cement, which can readily be washed. If the whole of the walls are not cemented, the part immediately behind the cooler should be cemented to the full height of the wall, and the remainder carried to a height of 4 ft. 6 in. The ceiling should be flat and easily cleaned. All drainage should be carried to the outside, and on no account should inside traps be fitted.

Outside Receiving Tank.—Traffic in and out of the dairy should be as little as possible. An outside receiving tank with a hinged cover and connected by a short length of movable piping to the strainer inside will avoid the necessity for entering the dairy with each pail of milk. The tank is approached by two or three brick or cement steps, and is protected at the sides and above by a small gable.

Dairy Equipment: *The Cooler.*—Since the cooler is one of the most difficult pieces of dairy farm equipment to keep really clean, care should be exercised in its selection.

Those coolers in which the corrugations are so close together as to render cleaning difficult should be avoided. Many coolers are now made with detachable metal covers, which prevent the contamination of the milk from the air. The movable metal strainer which fits into the top trough of the cooler is unnecessary and is difficult to clean.

The Strainer.—Straining of the milk is a necessity even on those farms on which great care is taken to exclude visible dirt. Nothing has yet been found which is better than good cotton-wool discs. These have the merit of cheapness, and can be discarded after each milking. Filter cloths are also good, but there is always the danger that they may escape efficient washing and sterilisation.

Churns.—The type and construction of the railway churn are matters of great importance, since many hours are often occupied by the carriage of milk by rail. Ventilation holes have been shown to be not only unnecessary but undesirable, since they permit contamination of the milk by dust and rain.

The ten or twelve gallon churn is preferable to the seventeen gallon churn, as they are much more accessible for cleaning purposes and take up less space in transit, particularly when the handles are set vertically instead of horizontally. Churns with no seams are now upon the market, and still further reduce the labour of cleaning. Insulated churns, which keep the milk cool upon its journey, can also be obtained, and it may be that there is a future for this type of churn.

The Sterilising Room.—Unsterile dairy utensils of all kinds are probably as much responsible for the premature souring of milk as the contamination received during milking and subsequent handling. This has been realised by many farmers who are now installing sterilising equipment of various types. If possible the washing up and sterilising should be done in a small separate room which may be under the same roof, but ought to be separated from the dairy.

Simple Steam Steriliser.—For small herds, up to 15 cows, the simple steam steriliser is an economical and efficient means of sterilising the utensils. In this apparatus steam is generated by two Primus oil stoves from a shallow pail of water which is provided with an insulated cover fitted with a short pipe acting as a steam duct, which is used for sterilising churns. This cover is replaced by a galvanised iron steaming box for sterilising the cooler and the rest of the utensils. Mr. Wilks, of Bewdley, Worcestershire, finds that with this apparatus he can sterilise the utensils necessary for a herd of from 20 to 25 cows at a cost of 3s. per week for fuel.

The Converted Farm Copper.—The ordinary farm copper may also be used successfully for sterilising purposes. A hole is bored in the existing lid and a short length of 2-in. piping inserted. This serves for steaming churns and pail. For sterilising the rest of the utensils the lid is replaced by a galvanised iron tank with a perforated bottom. The copper is filled about one-third full with water, which must be kept vigorously boiling throughout the steaming process.

A simple and effective steaming outfit at a small cost has recently been put on the market. It consists of a boiler, which yields 35 gallons of hot water for washing up, in addition to the necessary steam, and a large galvanised iron tank, fitted with a thermometer, for steaming churns, pails, cooler, etc.

Pressure Boilers.—Many firms make excellent small-pressure boilers, which are necessary for the larger farms. If possible the boiler should be in a small separate shed in order to avoid the dust of stoking. Accompanying these are steaming chests in galvanised iron on the floor of which there is a wooden rack which permits of drainage. A tank measuring 4 ft. 6 in. by 2 ft. 6 in. by 2 ft. 9 in. should provide the necessary accommodation for the utensils required for a herd of as many as sixty cows.

Whatever method of raising steam is chosen, it is necessary to see that the temperature is controlled by the use of a thermometer. For efficient sterilisation a temperature of 210 deg. F.,

maintained for fifteen minutes, should be aimed at. Hot and cold water troughs are necessary for washing purposes, and are preferably made in galvanised iron. Wooden tanks are not satisfactory, as they are difficult to clean and impossible to sterilise.

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STUDENTS' COMPETITIONS AT AGRICULTURAL SHOWS.

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Cornwall County Council.

SINCE the war one branch of the system of agricultural education in Cornwall has excited a good deal of interest and favourable comment among the farming public, namely the students' competitions at agricultural and fat stock shows.

The competitions originated many years ago as a means of advertising the work of the agricultural classes conducted throughout the county and have developed to an extent little thought of when they were first introduced.

A typical list of competitions such as those conducted at the fat stock shows at Truro, Helston and Wadebridge gives a good idea of their scope. There were eight as follows :—

1. Judging a fat steer.
2. Judging a long-woolled sheep.
3. Judging a utility hen.
4. Judging six roots, either mangolds or swedes, and six potatoes.
5. Judging samples of wheat, barley and oats.
6. Identifying and naming grass, clover and weed seeds (pure) and naming grass, clover and weed seeds in a mixture (10 species in each case).
7. Identifying and naming grasses, clovers and weeds, 20 species.
8. Naming and valuing foods and manures.

The whole of the competitions with the exception of the last three are judged by points.

At the agricultural classes the points are discussed and explained to the students and class sheets distributed giving the points to be looked for in detail. At the competition a bare skeleton without any explanation is used as a score card. The class sheets of the points of a fat steer and the mangold are given for comparison with the score cards used at the shows.

STUDENT'S SCORE CARD (CLASS SHEET).

POINTS OF A FAT STEER.

Scale of Points.	*Marks.*	*Student's Marks.*
GENERAL APPEARANCE, stylish and showing good quality	8	
HEAD. broad between the eyes, flat across the crown, *muzzle* broad, full, distinct and dewy; *mouth* large, *jaw* wide, *nostrils* large; *eyes* large; placid and clear; *horns* fine and symmetrical, set on the crest of the head; *ears* full and sensitive, of fine texture, well covered with hair	10	
NECK, medium length. full at the "neck vein" or "shoulder vein," broad, but fine and tapering towards the head, straight from the shoulder top to the roots of the horns		
SHOULDERS, well covered with flesh and laid back over the ribs, the *shoulder blades* adhering closely to the trunk; *shoulder points* fine...	8	
CHEST, full, wide, deep and massive, *girth* large, *crops* full	6	
BACK, broad throughout its length, smooth and even. *Forearm* and *leg* straight and short, *leg bones* dense and strong though smooth, *legs* well under the body	12	
BODY, long, deep, equally balanced before and behind. *Frame* well and equally covered with firm flesh, especially in the regions of the best cuts, not patchy on the hooks, tail-head, rump, shoulders or other parts. *Ribs* thickly fleshed, well sprung and deep. *Trunk* should resemble as nearly as possible a parallelogram; the under and upper *lines* straight and parallel	15	
HINDQUARTERS, full and well packed, lengthy from the *hook bones* to the *pin bones; rump* wide and even, *tail-head* smooth not patchy; *hips* smoothly covered, *thighs* broad, thick and well down towards the hocks; *twist* or inner thigh full, deep and plump. *Loin* thick and broad. *Flank* full and deep, even with the underline	16	
SKIN, moderately thick, pliable and mellow to touch. *Hair* soft and abundant, covering all parts ...	6	
TAIL, set on well back and falling perpendicular ...	6	
LINES of the body flowing, not sharp. *Carriage* stylish	6	
TOTAL	100	

All classes are open to farmers but so far only students have entered and at a convenient centre as many as 200 entries are not uncommon, mainly from students who are in their second or third year course, although the steer and sheep classes contain a number from the first year course. The entrants come from all parts of the county to take part and there is keen rivalry between the centres.

The show society, after consultation with the agricultural organiser and his staff, draw up the list of classes, the prizes to

STUDENT'S SCORE CARD USED IN COMPETITIONS.

Competitor's Marks.		Competitor's Number.

TRURO FAT STOCK SHOW
STUDENT'S SCORE CARD
FAT STEER

JUDGE :—

Scale of Points.	Maximum Marks.	Student's Marks.
1. GENERAL APPEARANCE	8	
2. HEAD	10	
3. NECK	7	
4. SHOULDERS	8	
5. CHEST	6	
6. BACK	12	
7. BODY	15	
8. HIND QUARTERS	16	
9. SKIN	6	
10. TAIL	6	
11. LINES AND CARRIAGE	6	
TOTAL	100	

be offered, and fix a nominal entrance fee (all of which are entered in the show schedule), and appoint the judges and the stewards.

In order that justice should be done to the student competitors some of the judges have attended the courses when the points of their particular competition were being discussed. Recently past students, who have been prominent prize-winners in previous shows, have been judges in conjunction with some well-known farmer. Both plans are excellent, as either method ensures the scores being compiled from the educational view point.

The competitions commence practically as soon as the show opens: this is very necessary as a good competitor who goes thoughtfully over the points, will not have finished much before the lunch interval.

In the classes for plants, weeds and seeds, the judges select and number 10 samples of plants, 10 samples of pure seeds and make a mixture of 10 seeds, and the competitors have to fill in the names on the numbered place of the corresponding card.

Feeding Stuffs and Manures.—The public take great interest in the foods and manures class. The cards used at the 1923 show at Truro are shown on p. 354.

It will be noticed that the competitors must identify six manures and six foods from their appearance and physical characters. Three other manures are given with their compositions, and it is required to calculate the money value of these

STUDENT'S SCORE CARD—(CLASS SHEET).

MANGOLDS.

Scale of Points.	*Maxim. Points.*	*Student's Marks.*
1. TRUENESS TO TYPE—Of Globe, Tankard or Long Variety. Of correct colour	15	
2. SIZE—Of moderate size only—density and regularity of form must not be sacrificed to size	20	
3. SHAPE AND FORM—Clean and regular in outline, no cracks or crevices, single tap-root; free from fangs; neck small and only moderate amount of foliage	20	
4. INTERNAL APPEARANCE—Flesh dense, no hollow spaces or tendency to sponginess, rings numerous with narrow interspaces	25	
5. SPECIFIC GRAVITY AND DRY MATTER—Should be high (often low in very large roots)	20	
TOTAL	100	

by the usual unit value method and award marks for their condition. In addition the competitor must fill in the price per unit and comment on the condition of three foods whose prices and starch equivalents are given.

After the judges have completed their score cards, and the stewards collected those of the competitors, comes the onerous task of correction and checking of scores, with the final awarding of prizes. It is no unusual occurrence to have a correct score by more than one competitor in which case the judge either divides the prizes between those tying, or if time permits sets a further test. The results are given to the society's official and the names of the winners posted on a prepared sheet.

All the competitions with the exception of the judging of the animals are conducted at a section of the show set apart for the purpose, and with each class is displayed an enlarged blank score card. When the competitors have finished, the whole is open to the public for inspection. The county agricultural staff are present to explain any points that arise during the criticism and comment that follow and in this way considerable advisory work results, the staff coming into contact with agriculturists whom they do not at other times reach.

STUDENT'S SCORE CARD USED IN COMPETITIONS.

Competitor's Marks	Competitor's Number

TRURO FAT STOCK SHOW
STUDENT'S SCORE CARD
MANGOLDS

JUDGE :—

Scale of Points	Maximum Marks	Student's Marks
1. Trueness to Type	15	
2. Size	20	
3. Shape and Form	20	
4. Internal Appearance	25	
5. Specific Gravity and Dry Matter ...	20	
TOTAL	100	

Competitor's Marks.	Competitor's Number.

TRURO FAT STOCK SHOW
STUDENT'S SCORE CARD
FOODS.

Judges:—

NAME THE FOODS NUMBERED

1 __________ 4 __________
2 __________ 5 __________
3 __________ 6 __________

Give the FOOD VALUE and VALUE PER UNIT and COMMENT on the CONDITION of the following FOODS

	Price per ton	Manurial Value	Food Value	Starch Equivalent	Value per Unit	Condition
7	£6 10 0	£1 5 0		61		
8	£13 0 0	£2 13 0		71		
9	£9 0 0	£1 10 0		78		

Competitor's Marks	Competitor's Number.

TRURO FAT STOCK SHOW
STUDENT'S SCORE CARD
MANURES.

Judges:—

NAME THE MANURES NUMBERED

1 __________ 4 __________
2 __________ 5 __________
3 __________ 6 __________

Give the VALUES of the following MANURES and MARKS for their CONDITION

	Nitrogen	Phosphates	Potash	Value	Condition, Max. Marks, 8
7	5·5 %	24·0 %	3·0 %	£	
8	3·25 %	18·0 %	2·5 %	£	
9	1·5 %	26·0 %	2·0 %	£	

ORCHARD IMPROVEMENT INSTRUCTION IN HEREFORDSHIRE.

A. J. MANNING,
Hereford County Council.

In 1912 the Agricultural Education Sub-Committee of the Herefordshire Education Committee inaugurated a scheme for improving the cultivation of the orchards of the county, and to induce the occupiers of the farms of the district to do justice to their trees and raise the standard of their produce to the pitch of perfection so easily attained in Herefordshire, even when a moderate amount of care, skill and attention is expended.

The scheme, in brief, was to carry on, for five years, annual competitions in orchard management. As a basis from which to start, the orchards were awarded points before any work was done on them, and they were visited twice each year by two local fruit growers, the late Mr. G. P. Berry, of the Ministry, and the County Horticultural Instructor. Such points were given above the original as it was considered the improvement warranted. Two medals were awarded each year to the competitors who showed the greatest and next greatest improvement; also a money prize in each case to the workmen who had had the care of these orchards. At the end of the five years it was intended that the occupiers of the orchard showing the greatest improvement should be presented with a very substantial piece of plate. Unfortunately, the cataclysm of 1914 upset the whole of the arrangements, and the scheme had to be abandoned.

One redeeming feature was the discovery that, notwithstanding the fact that Herefordshire had been almost continuously providing instruction in horticulture and fruit culture right from the inception of technical education, skilled pruners were almost impossible to be found outside the various fruit plantations of the county.

As soon as the results began to be noticeable in the orchards which were entered in the improvement competition, occupiers of the neighbouring farms began almost bombarding the agricultural education staff for names of men capable of pruning their orchards, with the result that regrets and apologies had to be sent in almost every case instead of names.

On the Armistice being signed, the writer was instructed by the Agricultural Education Sub-Committee to draft a scheme for the further development of horticultural education in the county, and, amongst other subjects, the improvement of grass orchards

came in for some very detailed suggestions. Remembering the great demand for pruners a suggestion for the systematic training of suitable men was put forward and adopted by the Committee, as being likely to be of much greater value than the old-time system of giving disjointed demonstrations and lectures. Events have proved the wisdom of the change.

The scheme put forward was to take a class of about six men, preferably those who were free to take different jobs during the winter months, smallholders who had some spare time on their hands, and jobbing men of any type, if, apparently, of reasonable intelligence and capable of doing a man's work, and giving these men 10 days' training of from $4\frac{1}{2}$ to $5\frac{1}{2}$ hours each day in pruning the different types of trees found in the average grass orchard of the county. This training was to be, if possible, followed up by instruction in grafting, spraying (in the seasons), and picking, grading, and packing the fruit.

There has never been any difficulty in finding pupils. In fact, in almost every case more have handed in their names than could be dealt with. This has enabled the instructor to select his students, and, in several cases, enough suitable pupils have clamoured for instruction to justify the holding of a second class in the same neighbourhood. If no other applications for classes reach the agricultural education office there are enough names on the waiting list to keep the staff fully occupied for the next two winters.

Arrangements for Starting Classes.—When an application is received from a farmer for a class he is told that he must make himself responsible for providing the pupils, he is also told what class of man is required, and the conditions on which the pupils are accepted. He is asked to impress on the men that they must undertake to put their knowledge and services at the disposal of people in their respective districts; they must attend the classes with reasonable regularity, and on the last day of the class must be examined in practice, and a knowledge of the reasons underlying such practice. If they pass the examination they are awarded a scholarship grant of 6d. per hour for each hour of attendance made. In case of failure to satisfy the examiner no award is made to them. The fact that their time would be lost to them in case of failure was thought to be a great inducement to careful attention to their instruction, and the writer has very little doubt that such is the case.

The instruction so far given has been entirely confined to standard trees, and—with one exception—on purely grass

orchards. So far as possible farm orchards having the greatest variety of types, sizes, and ages of trees, have been selected for teaching purposes. Each pupil is provided with a set of tools for which he is made responsible for the duration of the class. These tools are a curved Grecian saw with an eighteen-inch blade, one 10 ft. and one 8 ft. standard pruner, and he is taught to keep these clean and keen.

Method of Instruction.—On the opening day of the class, the theories underlying pruning are as carefully and thoroughly as possible instilled into the pupils. They are also shown how to use the tools in a proper manner, and above all, how to avoid doing damage with them if improperly used. When they appear to have a fair idea of the theory they are taken to some small tree which it is easy to prune, and asked to watch a demonstration by the instructor; criticise his work as much as they like; ask as many questions as they wish; and as the tree begins to show up in part its final and finished form, point out what they think should be cut out. By following this method of teaching it is found that the pupils readily acquire a keen sense of the necessary shape the finished tree should have. The next step is to take two trees as nearly alike to that on which the demonstration has been made, and as near together as possible. One half the class is placed to work in each tree, and each party is allowed to discuss the work as it proceeds, and the advisability, or the contrary, of cutting out any branch. It is found that although the first day's work does not amount to very much, the knowledge gained has been very considerable. On the second day, the students are worked in pairs, and usually after that it is found that individual working enables the instructor to give the necessary extra attention to any who appear to be less quick in grasping knowledge than their fellows. Working on these lines this past season, with a class of seven pupils, 164 half-standard trees of Bramley's Seedling, Newton Wonder and Lord Derby were satisfactorily pruned in six hours.

Each succeeding day larger trees are dealt with, and gradually the pupils progress until about the sixth day there is no further selecting done. The pupils are set one in each row and have to take any trees in their own lines as they come. In many cases these trees have a spread of 30 to 40 ft., and are absolutely matted with years of growth of tangled and wattled shoots. Some idea of the type of tree may be gained when it is stated that the first of these classes pruned a tree of Cummey Norman having a spread of the length of a cricket pitch!

The examination is held on the last day of the class, and usually one tree is selected for the purpose which will keep each pupil busy for the whole of the time allotted for a day's training; usually about 5 hours. Some idea may be gained of the type of trees usually selected from the accompanying illustrations Fig. (1) commencing work; and Fig. (2) one tree finished. In this case two trees per pupil were set as a task for the examination and were completed in 4 hours.

Grafting.—During the pruning instruction any of the common and least useful cider varieties, or any useless varieties found (locally known as kernels) are, if the owner wishes, beheaded with a view to regrafting in the following spring with more useful varieties which may, in some cases, be the better varieties of cider apples, but are, more generally, commercial apples. Bramley's Seedling and Worcester Pearmain are found to be two first-class varieties for this purpose, and, to a somewhat less extent, Newton Wonder and Annie Elizabeth are selected. In several places King Edward has been used and promises extremely well. In one orchard in the Bosbury district are several apple trees on which upwards of 100 grafts per tree were put, and these trees are doing well and are showing signs of commencing to bear now in the third year.

The principles underlying grafting are very carefully explained and suitable shoots of the current year selected during the pruning lessons and carefully set in the soil by the pupils for their use at the proper time. Some time in May the classes are called together and shown how to make the graft, and set to practice on some spare shoots kept back for instructional purposes. When considered sufficiently skilful they are set to work on the trees. Three methods only are taught, these being very simple to make and easy to fit to any size stock from the young stock of the nursery up to the orchard giant. It is emphatically pointed out that it is wise to keep a bud at the back of the cut in case of an accident to the graft after it has been inserted in the tree, or after growth has commenced. When this bud is kept a year is saved. Binder twine is used for tying instead of raffia, being more secure. In fact, it is practically impossible for a graft to blow out when so tied. The tie is not interfered with until the second year's growth is well advanced. It is then cut through from top to bottom, but not unwrapped until the end of the season. If it is pushed off by growth, well and good; if not, it stays there. Clay is available in most parts of Herefordshire, and it is used instead of wax; in practice, it is

FIG. 1.—Class commencing work on first of 2 trees set for examination.

FIG. 2.—First tree finished and work commenced on the second at the same examination.

found to be better than wax and much more economical. Warm wax has been found to be very risky, owing to the temptation to make it too warm to save so many journeys up and down the ladder. No very special preparation of the clay is found to be necessary when binder twine is used. It is made fairly wet and thin, and rubbed well in between the wraps of the string; then not more than ½ in. is well smoothed over the string and ends of the branches. If the coating is kept as thin as above mentioned it is very rare indeed that any falls off. It is when large lumps in thick layers are used that cracking and dropping off takes place.

Practically all the shoots which break from the cut-back branches, except in the immediate neighbourhood of the actual grafting, are allowed to grow for the first year, and somewhere about one half of these are allowed to continue for the second year.

When all shoots are prevented from growing after re-grafting a tree, there are not enough leaves produced to continue the economy of such a tree and very frequently the bark slips away from the branch during the first or second winter after grafting. This results in dead branches at least, and often in dead trees, but it is seldom that such mishaps occur when all growth is allowed to form for a time.

Effects of the Classes.—Since these pruning and orchard management classes were commenced in Herefordshire, twenty-one have been held, which means that, at least, 126 men have been trained. The benefit of this number of pruners in the county is becoming evident, and the evidence is cumulative from year to year. It is becoming noticeable in the orchards also in the greater demand for instruction in districts where none has yet been given. The call has been so insistent that during the past winter additional help has had to be obtained, and has enabled nearly double the number of instructional classes to be carried on.

There is another side to the instruction in orchard cultivation conducted in the county, *i.e.*, that in conjunction with the Winter Courses in Agriculture for Young Farmers. These courses have been conducted for many years, and two have been carried on during the past winter—the main one in Hereford, where classroom lessons in fruit culture were given on three mornings each week, and two afternoons each week were devoted to practical work.

Herefordshire is now taking up the fruit culture question from both ends, viz., with the young men who will be the farmers and fruit growers of the future, and with the men whom they will employ. There can be very little question that instruction correlated in this way for a few years will bring the orchards of Herefordshire to the position undoubtedly held a century or so ago, and such as, with persistent effort, can easily be attained again—that is, the finest in the country.

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THE CULTIVATION OF CHERRIES.

II.

A. H. HOARE,

Ministry of Agriculture and Fisheries.

II.—**SOUR CHERRIES.**—The sour or cooking cherries comprise the Flemish Red, Kentish Red and Morello varieties.

As a class they are more amenable to the ordinary plantation type of cultivation than sweet cherries, and for this reason are often found interspersed with other fruit in permanent plantations.

Large blocks of these varieties are often planted by themselves and on suitable soil the trees are prolific croppers.

Soil and Situation.—Sour cherries will succeed on any well-drained loose land and thrive particularly well on sandy gravels, brick-earths and flinty lands or chalk.

They are not quite so particular as to situation as sweet cherries and will even do well with a north aspect. Frost pockets and steep valleys should, however, be avoided.

Propagation.—Nearly all the sour cherries are grown either as half-standards or bush trees. The Mahaleb stock has been a popular one in the past, but the Common cherry, known as *Cerasus austera,* is often used. The Gean is also a suitable stock. There is no really dwarfing stock for cherries and it hardly matters which is used.

Planting and After Treatment.—Whether planted triangularly or on the square half-standards are usually placed at least 15 ft. apart each way and bush trees 10 ft. or 12 ft. each way. Bush trees should be planted on the square.

Sour cherries fruit on the young wood and, after the half-standard trees are shaped, pruning is not necessary. They are, however, not so intolerant of the knife as the sweet varieties and do not gum so freely. They may therefore be pruned, to keep them shapely or within bounds, if desired.

Bush trees also need no pruning after planting. The trees respond to good feeding, as in the case of sweet cherries.

Picking and Marketing.—Sour cherries hang better after ripening than do the sweet varieties, and the birds do not take them so freely. Like the sweet cherries, sour varieties are usually marketed in half-sieves or "quarters" (pecks).

Sour cherries as a class are mostly sold for culinary purposes, a certain quantity of Morellos being taken for the manufacture of cherry brandy. In addition to the demand for the fruit on the market for retailing there is a big demand from preserving firms for bottling purposes.

Varieties of Sour Cherries.—KENTISH RED.—(Middle July). *Fruit* medium size, round, dark red, transparent, with very tender, juicy, acid-flavoured flesh. A good cooking cherry and preserves well. *Tree* of medium growth and does well on half standards or bushes. Bears freely if planted with others, particularly Flemish Red. Self-sterile.

FLEMISH RED.—(End of July). This variety is the nearest approach to the wild cherry, *P. cerasus*. It resembles Kentish Red but the *fruit* is smaller and a little brighter red. *Tree* makes compact growth, is less drooping than the Kentish Red, and does well as a bush. Very free-bearing and self-fertile. Will succeed where the other varieties do not thrive so well.

MORELLO.—(August-September). *Fruit* large, inclined to heart-shaped, flattish, dark red or black when fully ripe. Flesh soft, juicy with briskly acid flavour. *Tree* is of a spreading, pendulous habit of growth, and succeeds as a standard, half standard or bush. It is remarkably prolific, self-fertile, and the fruit will hang a long time.

There are really two varieties of Morello in existence. The old-fashioned, smaller variety is most sought after for the manufacture of cherry brandy. The Morello is the best of the sour cherries for all purposes.

DISEASES AND PESTS OF CHERRIES.—Cherries are liable to a good many diseases and pests, the principal of which are described below.

Brown-Rot.—The blossom, shoots and fruit of cherry trees are attacked by the brown-rot fungus, *Monilia cinerea*, var. *pruni*, which causes considerable damage in wet, cold seasons. The fruit may also be attacked by the allied species *Monilia fructigena*. The disease varies in intensity with the season and is difficult to control in cherry trees on account of their size. It is specially important that no mummied cherries should be allowed to remain on the trees, as these constitute a sure means of carrying the disease over from year to year.

The Kentish and Flemish varieties are very susceptible to Brown-rot attacks and some of the sweet varieties are more subject than others.

For further particulars of this disease and its control Leaflet No. 367 (*Wither-tip and Brown-rot of Plums*) should be consulted.

Cherry Leaf Scorch.—This disease has the effect of withering up the leaves on the shoots. They remain hanging there throughout the

winter and may be seen as late as May. It is caused by the fungus known as *Gnomonia erythrostoma*. The dead leaves which hang on until the following spring should be removed and burnt in the case of all trees in which they are readily accessible, since they are the means by which this fungus is carried over from season to season. For larger trees two sprayings with Bordeaux mixture, one just before the blossoming occurs and the other directly afterwards, have been found to give effective control.

Silver Leaf.—This disease has made heavy attacks on cherries during the past few years. Napoleons and Turkey Hearts are especially susceptible to attack, as also are all the sour cherries. Trees which have been headed back (pollarded), or headed back and grafted, are also very liable to attack. Care should be taken to see that no wounds are left for long uncovered, and grafting operations should be expedited as much as possible. For further particulars of this disease and its control see Leaflet No. 302 (*Silver Leaf in Fruit Trees*).

Witches' Brooms.—Another serious disease, which is caused by the fungus *Exoascus cerasi*, results in the formation of the so-called "Witches' Brooms." The fungus mycelium is present in the branches and stimulates them to produce numerous twigs which together take on a form roughly comparable to a loose broom. The leaves borne by these abnormally branches twigs are also penetrated by the fungus which ultimately produces countless numbers of spores on their surfaces. Such leaves are usually wrinkled or crumpled and reddish in colour. These brooms are always barren and since they serve as centres from which the disease is spread they should be promptly cut out and destroyed by fire.

An allied fungus, *Exoascus minor*, causes a blister or curl of cherry leaves somewhat similar to peach leaf-curl, but this trouble is not common.

Gumming.—Gumming is a trouble which affects some varieties of sweet cherries more than others. Trees upon which the knife has been used tend to gum excessively. If the gumming is very bad and persistent it is generally taken as a sign of an unhealthy condition of the tree, but there seems to be no remedy. The cause of gumming in cherries is obscure, but it does not appear to be due to any fungus or other parasite.

Winter Moths.—The chief insect pest of cherries is the winter moth. All standard and half standard trees should be grease banded to prevent the ascent of the females. The bands should be maintained in an effective condition throughout the year and replaced annually in fresh positions on the trunks of the trees. When, however, this is neglected and caterpillars are found to be feeding in the spring, they may be destroyed by spraying if the trees are not too large to admit of it. See Leaflet No. 4 (*Winter Moths*).

Lackey Moths.—Periodically the attacks of the caterpillar of this moth become epidemic and cherries which cannot be sprayed early with lead arsenate may then suffer severely. Under these circumstances mechanical measures such as tearing down the webs and the collection in winter of the egg bands may have to be carried out—at a cost which exceeds that of an efficient high power spraying installation. See Leaflet No. 69 (*Lackey Moth*).

Cherry Black-Fly.—This black aphis (*Myzus cerasi*) is another serious insect pest. In some seasons it swarms over the shoots and under the leaves, causing the latter to curl up. The honey-dew issuing from this pest gums up the leaves and if it gets on the fruit spoils it. The leaves and shoots are often killed outright if the attack is bad.

The only remedy is to spray early with a good nicotine insecticide or soft soap and quassia, providing, of course, the trees are not too large for spraying. The successful spraying of cherry trees depends largely on the plant employed. With an efficient power plant trees of any size may be sprayed thoroughly.

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COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Thirteenth Meeting of the Council of Agriculture for England was held on May 22nd, 1924, at the Middlesex Guildhall, Westminster. The Chair was taken by Mr. George Edwards, M.P.

Appointment to the Agricultural Advisory Committee for England and Wales.—At separate meetings of the Minister's members and County and Borough Agricultural Committees' members held previously to the full Council meeting, the following members were elected to the Agricultural Advisory Committee: (1) Mr. Robert Hobbs, of Kelmscott, Lechlade, Gloucester; (2) Mr. James Donaldson, of Brightwell Baldwin, Wallingford, Oxon; (3) Lt.-Col. Sir Merrik Burrell, Bart., C.B.E., J.P., of Knepp Castle, Horsham; (4) Mr. J. R. Spraggon, of Blaydon Burn House, Blaydon-on-Tyne. It was announced that a further vacancy had been filled by the Minister by the election of the Hon. E. G. Strutt, C.H., of Whitelands, Hatfield Peverel, Essex.

Statement by the Minister.—In the course of the Minister's statement, which covered the period which had elapsed since the last meeting in February, he stated that the decline in the number of cases of foot-and-mouth disease had been from 99 in the week ended 2nd March to 9 in the week ended 22nd April, since when the weekly averages had been 9, 11 and 13. Improvements had been made in the methods of disinfection of railway trucks, vans, etc., and special inspectors had been appointed to supervise the working of a new Order on the subject.

The Minister invited the special attention of members of the Council to the Ministry's exhibit at the British Empire Exhibition, and also to the agricultural films which had been

prepared and were being shown there. In regard to drainage work for the benefit of the unemployed, the number of schemes carried out last season was 399, of which water supply schemes numbered 71. The immediate cost to the State had been £276,000, of which £33,000 was recoverable, and the total expenditure represented by the schemes was £391,000. The number of men who were being employed upon them at the end of the season was 7,000 per week. Schemes for next autumn and winter were being prepared on the assurance that further Government money would then be available for the purpose. The Minister also announced that a Committee was being set up "to advise as to the administration of any public monies that may be made available for the assistance of Agricultural Co-operation or Credit."

With regard to the suggestion in the Linlithgow Report that the public and the farmers should interest themselves more in new types of wheat, the Minister referred to the research work being done at Cambridge and other stations, and especially to the work of Professor Biffen at Cambridge. "Yeoman" wheat was very good and was being further improved upon by other types. Prices had improved by the demand which was growing amongst millers for these better wheats, and the public should assist by asking for bread made from British flour from them, which would be found to be very good. He had himself tried it in his own house, and friends without knowing which was which had pronounced in favour of British bread over the ordinary bread supplied. He was not ashamed to confess to a sentimental preference for British food. In reply to a question by Sir Douglas Newton, the Minister said that the Department would not be able to give the full results of the reported discovery of the germ of foot-and-mouth disease on the Continent, but that they had been promised at an early date. A cordial vote of thanks to the Minister for his address was put to the meeting and carried unanimously.

Sale, etc., of Land used for Allotments.—Mr. J. Forbes moved a resolution to the effect that where land had been purchased by local authorities for use as allotments they should not be permitted to sell it or dispose of it for any other purpose unless they had the consent of the Ministry of Agriculture and Ministry of Health. The resolution was seconded by Mr. Woodhead (Yorks), and, in the course of the discussion, Mr. W. R. Smith, M.P. (Parliamentary Secretary of the Ministry of Agriculture) pointed out that it had been agreed at another Committee

that the recommendation should rather be "with the consent of the Ministry of Health after consultation with the Ministry of Agriculture." Mr. Smith said that legislation would be required to give effect to the proposal, and that there was no present prospect of this being practicable. The resolution was passed.

Further Compensation for Foot-and-Mouth Disease.—Mr. W. McCracken (Cheshire) moved a resolution to the effect that the compensation paid to farmers for cattle destroyed through foot-and-mouth disease should be supplemented to meet at least a portion of the loss due to the suspension of production and earnings, and to the increased cost of replenishing stocks, giving special attention to the circumstances of the earlier outbreaks when valuations were relatively low; also that farm labourers should be compensated for loss of employment and wages due to the slaughter of herds. The resolution was seconded by Major H. E. Wilbraham (Cheshire). Mr. Donaldson (Oxford) said that there had undoubtedly been cases of individual hardship in Cheshire, but that the matter must be looked upon broadly. If the cart were overloaded, there was a likelihood that the wheel might come off. As it was, a very large amount of money was being spent in the eradication of the disease and in compensation. Mr. W. R. Smith, M.P., said that legislation would be required to give effect to any such proposal as had been made, and that probably the best way to deal with the suggestion would be to refer it to the Departmental Committee now sitting which was reviewing the circumstances of the present outbreak. Mr. Owen Webb (Cambridge) said he could not support the resolution, adding that the losses incurred by farmers who had had no disease amongst their stock through being unable to market their stock were far greater than the amounts paid in actual compensation. The motion was put to the meeting and lost.

County Councils and Land Drainage.—Mr. J. R. Spraggon (Durham) proposed a resolution that in view of the urgent need of land drainage for the reclamation and improvement of agricultural land H.M. Government be requested to bring in legislation giving county councils the necessary powers to deal with the matter. He said that much of the land in the country was not producing anything like its proper amount of food through lack of proper drainage. Some occupiers did not keep their ditches, watercourses and outfalls properly cleansed, and there was little use in one person cleaning out his ditches, etc., if his neighbours below him did not clean theirs out also, and

so give him a proper outfall for the water. Two counties, Lancashire and the West Riding of Yorkshire, had promoted private Acts of Parliament to give them powers to deal with such matters. The problem, however, was a national one, and every county ought to have similar powers. Lord Bledisloe seconded the motion and said that thousands of acres were yielding less than half their potential output through lack of effective drainage, and drainage problems could not be dealt with piecemeal. He thought that legislation on the subject would be non-contentious and would have the support of both Houses of Parliament. Capt. Hotchkin (Lindsey) and other members also supported the resolution, and Sir Francis Floud (Permanent Secretary of the Ministry of Agriculture) stated that the Department were quite in agreement with the object of the resolution, and were as a matter of fact actually in communication with the County Councils' Association as to the precise lines of fresh legislation. He added that much could be done under the existing powers and under the special unemployment schemes. It was, he said, generally agreed that no part of the funds which had been devoted by the Government for the relief of unemployment had been more usefully expended than those applied to land drainage. It had recently been agreed that County Committees could retain their drainage staff during the summer so that schemes for autumn and winter might be prepared during the summer months. If full advantage were taken of this and of the power given to County Councils under Section 16 of the Land Drainage Act it ought to be possible to deal with the matter effectively.

Resolutions Passed at Last Meeting.—Sir Francis Floud reported, on behalf of the Ministry, the action which had been taken by the Ministry upon the two resolutions passed at the last meeting which called for such action. The first was to the effect that legislation was required to provide for one authority only for the control of animal diseases in each geographical county. The Ministry was in full sympathy with the object of the resolution, but legislation would be required to give effect to it. That matter was now under consideration with the Ministry of Health and the Secretary for Scotland. It raised a difficult question in regard to the relationship between county boroughs and county councils, and the Ministry also wished to consult the County Councils Association and the Association of Municipal Corporations upon it. It was obvious that no legislation was practicable in the present Session, but

the Ministry hoped to make an advance later in the year. The second matter was the resolution recommending that the Minister should invite the Directors of the Animal Nutrition Institutes at Aberdeen and Cambridge to report on the further facilities which were required for the purpose of research of animals in Great Britain. Within the last few days, Professor Wood and Mr. Orr, the Directors concerned, had made a report which the Ministry were considering. The report would be handed over to the Standing Committee of the Council with the observations of the Ministry upon it, and when the Standing Committee had considered it, they would no doubt bring it before the Council.

Resignations of Certain N.F.U. Members.—The Right Hon. F. D. Acland, M.P., Chairman of the Standing Committee of the Council, moved the acceptance of the report from the Standing Committee on the subject of these resignations.

Report on the resignation from the Council of certain of the National Farmers' Union Members.

The Standing Committee has had under consideration the question of the resignation of 25 members of the Council who are also members of the National Farmers' Union. It regrets very much that so many members of the National Farmers' Union on the Council have resigned, and wishes to make it clear that the statement that the members have resigned because the Council claims to express "the authoritative opinion of agriculturists" cannot be correct, as the Council has made no such claim. The phrase occurs in paragraph 7 (b) of the report of Lord Clinton's Committee, which was adopted by the Council at its last meeting. In this report the duties of the Standing Committee are outlined and the paragraph reads as follows:—

"7 (b) To keep in close touch with the Agricultural Advisory Committee for England and Wales and to ascertain from time to time whether the Minister of Agriculture desires to set down for discussion by the Council one or more subjects on which he wishes to gather the authoritative opinion of agriculturists."

This statement in no way suggests that it was the intention of Lord Clinton's Committee to propose to the Council that it should assume a new position. No change whatever has, in fact, taken place in the attitude of the Council, whose duty it still is, as it has been since its formation, to carry out the role and functions laid down for it in the Ministry of Agriculture and Fisheries Act, 1919.

The formation of the Standing Committee marked only the desire of the Council that it should be put in a position to discharge its statutory duty with greater efficiency, and in the opinion of the Standing Committee it is a matter for regret that this action should have been made the occasion for resignations.

The Standing Committee believes, however, that the Council will desire to express its agreement with a statement recently made on behalf of the National Farmers' Union on one point. Mr. Robbins stated at the meeting of the Council of the Union

held on April 16th that recent events had "proved their whole case, namely, that the National Farmers' Union . . . never had the right to instruct any member of the National Agricultural Council how he was to vote." The Standing Committee concurs in the view that members of the Council do not serve as delegates voting under instructions, but, on the contrary, are called upon to exercise their own judgment on matters coming before them.

In your Committee's view it would be a distinct change in the conception with which the Council was set up if any of those appointed, either by the County Agricultural Committees (in the exercise of their statutory duty) or by the Minister, should regard themselves as subject to the instructions of any particular organisation connected with agriculture. And the Committee trusts that the Council will record for the guidance of those who may be appointed to take the place of the members who have resigned that there has been no change since the original setting up of the Council either in this matter or in the position of the Council as representing the agricultural industry.

Mr. Acland suggested that the report be adopted, and should be sent to those County Agricultural Committees which had under their statutory duty to fill up the vacancies which now existed. Lord Clinton said he thought it a matter of serious regret to the Council that so many members of the National Farmers' Union should have thought it necessary to withdraw from the Council at a time when it was endeavouring to improve its procedure. He said he valued the Council very greatly because it was the only place where people of all classes engaged in the industry and all sections had a right to meet, and where there might be always a free expression and a free discussion of all matters. Lord Bledisloe said that the Council owed a debt of gratitude to Mr. Acland and Lord Clinton for the impartial and statesmanlike attitude they had adopted towards this problem. Nothing could be more detrimental to the future of the industry than the over-emphasis of sectional sentiment. He ventured to hope that the National Farmers' Union delegates would rejoin the Council. Colonel Courthope, M.P. (East Sussex), said he would be sorry if readers of the report went away with the impression that the Council was very humble. He believed that if the reforms of procedure which Lord Clinton's Committee suggested were carried out in the spirit put forward, the Council would be recognised as a powerful agricultural body. Mr. Donaldson (Oxon) said that as one who had had some little pressure upon him to resign from the Council he was bound to say that he thought he would be doing his duty much better by not resigning. Reforms in the Council's procedure came much better from within, and it was not right for members to run

away from their duty. The one agreed object of Council meetings was that all three parties could come together without prejudice and discuss the aims and objects of all sections.

The Chairman (Mr. George Edwards, M.P.) said that he felt most keenly the action of the National Farmers' Union at the last meeting. Their President had made a proposition that he should take the Chair, and had no doubt done it with the best of motives, but before the meeting was over he found that the leaders had organised an upsetting of the business of the Council, and the meeting was compelled to adjourn. Even now he hoped that the National Farmers' Union leaders, many of whom he knew and held in great respect, would reconsider their position and return to the Council. The report was then received and adopted, and Mr. Acland's suggestion agreed.

Interim Report on Agricultural Education and Research.—The Chairman of the Standing Committee (Mr. Acland) reported that the Standing Committee had got together some very useful and interesting information on agricultural education and research in England and Wales, but had not yet got comparable information from Scotland. It therefore proposed to postpone the report until the Committee was in a position to present a complete statement in regard to Great Britain. The Council agreed to this proposal.

Quorum.—Sir Douglas Newton, M.P. (Cambs), proposed that the Minister be asked to revise the statutory regulations and make the quorum for the Council 25 members instead of one-third (47). The quorum in the House of Commons was one-fifteenth of the total number, and he thought the present suggestion, which would reduce the one-third to about one-sixth, would be the right basis for the Council to adopt. Mr. Cross (Berks) seconded the motion, which was carried unanimously.

Elections to Standing Committee.—The Council elected Mr. James Hamilton (Lancs) and Capt. E. T. Morris, J.P. (Herts), as tenants of agricultural land, to fill vacancies on the Standing Committee.

Unemployment Insurance and Agricultural Labourers.—Mr. Dallas moved—

> "That the Standing Committee of the Council be instructed to appoint a Sub-Committee (with power to co-opt) and the Ministry of Agriculture be requested to assist it with the services of their officers, and the Ministry of Labour with the services of the Government Actuary, in order to ascertain whether the basis of a scheme for unemployment insurance suitable for the industry of agriculture can be worked out, so that a further report may be presented to the Council."

Sir Arthur Hazlerigg (Leicester) seconded, and after discussion, in which the Minister of Agriculture joined, the resolution was carried.

Weighing of Fat Cattle for Sale.—Mr. Donaldson (Oxon) moved—

> "That the Council urges the Ministry of Agriculture to promote legislation to make compulsory the weighing of all fat cattle on being exposed for sale in any public market, the weight of each beast to be declared at the time of sale."

This was seconded by Mr. James Hamilton (Lancs) and supported by Mr. H. W. Thomas (Hants), Mr. Wm. Hawk (Cornwall), and other members, put to the meeting and carried after an amendment that the word "fat" should be deleted had been proposed and lost.

Accounts of Holding Companies.—Mr. A. W. Ashby proposed—

> "That the Council asks the Ministry of Agriculture to press the Board of Trade to introduce legislation to require the publication by holding companies of annual returns of profits and costs as recommended in the Linlithgow Committee Report on the Milk Industry."

Mr. Woodhead (Yorks) seconded. The Minister of Agriculture said that the matter was receiving the attention of the Board of Trade and that they would no doubt give their best consideration to the question. The resolution was agreed to.

Development of Rural Industries.—Mr. A. W. Ashby moved the following resolution—

> "That with a view to the further development of rural industries throughout the country, (1) funds should be provided to enable the Rural Industries Sub-Committee of each County Agricultural Committee to carry out the functions which it was intended to carry out, and (2) grants made to the Rural Industries Intelligence Bureau should be maintained for the present."

Mr. Woodhead (Yorks) seconded and after discussion the resolution was agreed unanimously.

Illegality of Milk Licence Charges.—Lord Strachie moved the following resolution—

> "That the Ministry of Agriculture be asked to state what steps have been taken, or will be taken, under the exemption of milk from the War Charges (Validity) Bill, to secure that farmers who were illegally deprived in four western counties of 2d. per gallon shall as far as possible have this made good to them."

The resolution was duly seconded, and discussed. The Minister of Agriculture pointed out that Milk Charges were not now to be included in the War Charges (Validity) Bill. The money held by the Government in respect of these

charges, amounting to £105,000, would be repaid to the persons from whom it was received, namely, the distributing companies. The money held by these companies and not paid to the Government was stated to be £160,000, and the total amount involved was therefore £265,000. It had not been the farmers who had been "illegally deprived" of the money; it was the distributors. He explained the history of the matter and said that he thought the best proposal on which he could act was to suggest to the distributors that the money might be devoted to research for the improvement of the dairying industry. After further discussion, in the course of which amendments were moved, the resolution was dropped, it being agreed that the Council proceed to the next business.

State Agricultural Policy.—Mr. Robert Bilsland (West Suffolk) moved—

> "That it is desirable that the Council of Agriculture for England should take immediate steps to assist the Government and the agricultural industry by framing a policy having as its objects (a) the maintenance within safe limits of the home-grown food supply, and (b) the stabilisation of the agricultural industry, and that for the purpose the Council should appoint a committee of owners and occupiers of agricultural land and agricultural workers with an instruction to prepare a policy as aforesaid and submit the same to the Council for consideration with the least possible delay."

This was seconded and the importance of the very careful drafting of terms of reference to the Committee stressed by Lord Clinton. Mr. Acland suggested that the Standing Committee might be instructed to prepare terms of reference and prepare personnel for the Committee. A resolution was accordingly carried that the Standing Committee should so act.

Unemployment Grants for Land Reclamation 1924-25.—Mr. W. Hawk (Cornwall) proposed the following resolution—

> "That the Ministry of Agriculture be approached with the view of obtaining unemployment relief grants for the 1924-25 season towards the cost of approved land reclamation schemes."

It was seconded and agreed.

Unemployment Grants for Land Drainage During the Summer.—Mr. Davis (Durham) proposed the following resolution—

> "That the Minister of Agriculture be urged to consider again the question of authorising the continuance of works of land drainage for the alleviation of unemployment during the summer months, and that the necessary financial provisions should be made for the purpose by the Government."

The resolution was seconded and after discussion put to the meeting and lost.

A Report on Seasonal Agricultural Labour.—Lady Mabel Smith (Yorks) moved—

"That the Ministry be asked if they have any information as to the conditions of seasonal labour, especially as regards women and children, and whether such information can be supplied to the Council in the form of a report."

Mr. Dallas seconded, and Sir Francis Floud, on behalf of the Ministry, said that the Ministry quite recognised the importance and interest of the subject. The Ministry had a certain amount of information, although it was not extensive enough to make into an authoritative report. It would, however, be glad to prepare a report for the next meeting of the Council.

Further Relief of Agricultural Rates.—Mr. R. L. Walker (Yorks) moved—

"That the Government be asked to consider the question of further relief being given to agricultural lands from the burden of local rates."

Mr. Hamilton (Lancs) seconded the motion, which was agreed after discussion.

Report of Agricultural Advisory Committee.—Sir Douglas Newton moved that the Report from the Agricultural Advisory Committee of England and Wales on their proceedings be received by the Council. The Report was received and is printed below.

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AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

THE following is the half-yearly report (No. 7) to the Councils of Agriculture for England and Wales, on the proceedings of the Agricultural Advisory Committee :—

In response to a request which has been put to us by the Standing Committee of the Council of Agriculture for England on behalf of the Council, we propose in future to make four reports to the Councils in the year instead of two as heretofore. Each report will, as a rule, be made up to such a period before the date of the meeting of the Council of Agriculture for England as will allow of members of the Standing Committee receiving it for consideration a month before the Council meeting.

Between the 30th November, 1923, the date of the last report, and the date of the present report, the Committee has met five times, namely, on the 12th and 31st December, 1923, and 1st February,

6th March, and 2nd April, of the current year. The following subjects were under consideration in the course of these meetings:—

(1) **Foot-and-Mouth Disease.**—This subject has unfortunately been a constantly recurring one on the agenda of the Committee during the period covered. At each meeting the Committee has been informed by the chief veterinary officer of the Ministry of the general position in regard to the disease, and of details of any aspect of it which the Committee wished to discuss. At the meeting of the 12th December the serious situation in Cheshire was carefully considered. The Committee was informed that the large number of outbreaks occurring in this district was due to the fact that it was densely stocked with cattle, and that the dearth of slaughtermen made it impossible for the preventive measures to keep pace with the disease. At this meeting, the Minister reported that the Cabinet Committee had agreed to the continuance of the present policy of slaughter and compensation up to a net cost of 1½ million pounds, when the question would again be considered by the Committee. The subject of further scientific investigations in connection with the disease was discussed, and it was agreed that the Minister (Sir Robert Sanders) should consult Sir Walter Fletcher, Secretary of the British Medical Research Council, on the subject.

The meeting on the 31st December was a special meeting confined to the consideration of matters arising out of the foot-and-mouth disease outbreak, the main question at issue being the continuance of the slaughter policy, especially in relation to the Cheshire area. It was stated that the Cabinet Committee had authorised the Ministry to continue payments in respect of slaughter and compensation until the matter was again considered. The Ministry's chief veterinary officer reported that the disease was now being overtaken in Cheshire, and that, with reference to the resolution passed at the last meeting of the Council of Agriculture (13th December) that the slaughter policy ought to proceed until the Ministry's veterinary authorities advised that a change should be made, he was not at present prepared to advise a change. It was reported that Sir Francis Floud, Permanent Secretary, and Sir Stewart Stockman, Chief Veterinary Officer, had attended meetings in the Cheshire district, and explained that isolation as an alternative to slaughter would involve very drastic regulations if it were to be effective. It would mean that a farm would have to remain under severe restrictions, which would certainly preclude the restocking of it for six weeks to two months after disinfection, and, under such a system in Cheshire, it might be a year before the disease could be eradicated from the county. The question of holding up the store cattle trade was also considered in view of the danger of store cattle spreading the disease in their passage through the country. It was not decided, however, to recommend that the store cattle trade should then be held up.

At the next meeting of the Committee, 1st February, 1924, after a statement by the chief veterinary officer had been made, a resolution was agreed to "that the Agricultural Advisory Committee, having examined the present position, are satisfied with the arrangements made in checking the spread of foot-and-mouth disease."

It was also agreed by the Committee that it be recommended that all local authorities' Orders affecting movement of animals should be

submitted to the Ministry for approval before they became operative. The appointment of a small committee to examine the administrative questions arising out of the present outbreak of disease was also agreed. The question of the importation of Canadian cows and heifers to restock depleted Cheshire farms was examined and the Ministry's action in replying that it was not a matter on which they could authorise importation approved.

At the meeting on 6th March, the chief veterinary officer reported the setback due to infection arising from the markets of Northampton, Nottingham and Lancaster. The question of a general Standstill Order on all cattle, sheep and pigs, including those for slaughter, for three weeks, was considered and thought to be likely to be ineffective owing to insufficiency of the period of standstill, even if it were practically possible. The question of the thorough disinfection of railway trucks was also discussed.

At the following meeting on the 2nd April, the chief veterinary officer was able to report to the Committee that the outbreak was, on the whole, definitely on the down-grade. There was still some danger due to the distribution of manure from slaughterhouses. In regard to disinfection of railway depôts, sidings, loading docks, etc., inspectors had recently been appointed whose exclusive duty would be to examine into actual methods adopted by railway companies, and to report to the Ministry. A new Order had been published defining the manner in which the proper disinfection of railway trucks should be carried out.

(2) **Meeting with the Prime Minister.**—On the 1st February, the Committee was summoned to a special meeting with the Prime Minister at Downing Street. The Prime Minister was accompanied by the Rt. Hon. Noel Buxton, M.P., Minister of Agriculture, and Mr. Walter R. Smith, M.P., Parliamentary Secretary. In the course of his remarks, the Prime Minister said that he had invited them to see him in order to assure them that the Government was exceedingly anxious to tackle the agricultural problem and that it regarded the condition of the industry as a national concern. While the Government had to rule out any hope of protection or subsidies of the kind suggested hitherto, it was most earnest in its desire to be of every possible assistance in other directions, and a special committee of the Cabinet had been appointed to examine the problem. The Government would welcome any advice and guidance from practical men who knew the difficulties and who would make suggestions for basing agriculture on a sound, scientific and business-like footing. The Prime Minister said that he felt that the great contribution that the Labour Government could make to the solution of the question was that they will relate the problem of the country to the problem of the town, and that if the agricultural problem was treated as merely a farmers' or a farm labourers' one no solution at all would be arrived at. Short speeches in reply were made by Mr. R. R. Robbins, Mr. Geo. Edwards, M.P., Lord Ailwyn, Sir Douglas Newton, M.P., Lord Clinton, Mr. McLaren, and Mr. McCaig, all of whom expressed the appreciation of the Committee at the invitation to meet the Prime Minister and their desire to assist the Government in regard to any measures which could be taken for the benefit of Agriculture.

(3) **Summer Time.**—The resolution of the Council of Agriculture that summer time should be confined to four months only, commencing the beginning of May and finishing at the end of August, with the qualification that if a longer period was considered desirable in the national interest, it should be continued up to the end of October to cover the potato-lifting season, was considered by the meeting on 1st February. The statements made by the members of the Committee were noted by the Minister.

(4) **Allocation of Fund of £850,000 for Agricultural Education and Research.**—At the meeting of the 1st February, information was circulated dealing with the position in regard to agricultural research as it had been aided from this fund. It appeared the subject had been well provided for, and that a good margin existed for development of further research where needed, and also that educational schemes, including farm institutes, which required money could also be developed. The question of assistance to the Rowett Institute at Aberdeen was raised, and it was pointed out that the matter was one for the Scottish Board of Agriculture to deal with out of the grant of £150,000 made to Scotland. It was also agreed that the Reaseheath, Cheshire, farm institute scheme should be approved, the expenditure on the buildings having been cut down by about £4,000.

The question of a grant to the Monmouthshire farm institute was considered at the meeting on the 6th March and agreed.

(5) **Co-operation and Credit in Agriculture.**—The Committee considered at their meeting on 6th March, memoranda which had been circulated dealing with credit and co-operation in agriculture, and also Leaflet 311 on the formation of agricultural credit societies. In regard to these societies, the Committee was informed that it was to meet the difficulty of uncalled liability possibly preventing non-borrowers from taking up shares in a society, that it had been suggested that the best method of forming the societies would be through existing co-operative societies. These latter would take up shares and would to a large extent control the business; that is to say, loans advanced to members would be expended through the trading society, and they would have the whole matter under their own control. Borrowing members would only be required to subscribe the minimum amount to qualify for loans, *i.e.*, one-tenth, the balance being subscribed by the co-operative society as a non-borrower. That applied both to co-operative societies and to other organised bodies, for instance, a local branch of the National Farmers' Union. The administration and funds of the credit society and the co-operative society would be absolutely separate, although they might have the same executive committee. The object of this was that the funds of the credit section of the society should not be jeopardised by injudicious business on the trading side. Certain difficulties which appeared to stand in the way of success of the credit movement were discussed, and the Minister informed the Committee that he proposed to appoint a standing advisory committee, which would assist with the whole question of co-operation and credit and would naturally go into these questions along with others arising.

(6) **Resignation of National Farmers' Union Members.**—This matter was referred to at the meeting on the 2nd April, when it was agreed that it might usefully be considered at the next meeting of the

Council of Agriculture in connection with any proposals to re-model the constitution of the Council, which would, however, involve legislation to give effect to it. In the meantime, it was understood that the various responsible authorities would be invited to fill the vacancies.

(7) **Draft Bill providing for the Importation of Pedigree Stock.**—The Committee at their meeting on 2nd April considered a draft Bill which had been drawn up on the lines of the agreement made at the Imperial Economic Conference to allow the Minister to admit pedigree stock from a Dominion when satisfied that that Dominion was ready to take British pedigree animals on reciprocal terms, provided also that he had previously approved the herd or flock book in which the pedigree animals of the Dominion were registered.

(8) **Resolutions from Standing Committee of the Council.**—Two resolutions of the Standing Committee (1) suggesting that it should be permitted to see the agenda of the Advisory Committee, (2) that the Advisory Committee should make four reports per annum to the Council instead of two as heretofore, were considered and agreed to.

(9) **Reports from other Committees.**—A report for the three months ended 11th February, 1924, was presented at the meeting on the 6th March. It covered notes on the proceedings of the Basic Slag Committee, Committee on Agricultural Economics, Electro-Culture Committee, Animal Pathology Research Committee, Agricultural Research Council, Conference of Advisory Officers, Central Scholarships Committee, the Livestock Advisory Committee, and other Committees.

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CERTIFICATION OF POTATOES.

THE various Orders which have been issued by the Ministry during recent years under the Destructive Insects and Pests Acts for the control of plant diseases and insect pests have been based on what may be called a "clean seed" policy, *i.e.*, a policy by means of which purchasers of nursery stock, bulbs, etc., may be given some assurance that the goods purchased are free, at least from the more serious diseases to which they are liable. Thus, imported plants, bulbs, etc., are required to be accompanied by a certificate that they are healthy and free from certain specified diseases, and the sale in this country of plants substantially attacked by specified insects and diseases is prohibited.

Last year it was decided to extend the "clean seed" policy to the control of Wart Disease of Potatoes, and this was effected by embodying in the Wart Disease of Potatoes Order, 1923, a requirement that all potatoes planted (except "own saved" seed) and all potatoes sold for planting must be the subject of an Official Certificate. The requirements of the Order and an explanation of the system of certification were set out in an

article published in the issue of this *Journal* for July, 1923 (p. 363).

The certificates specified by the Order as regards potatoes grown in England and Wales are of three kinds :—

(*a*) A certificate to the effect that the potatoes were grown on land believed by the Ministry to be free from Wart Disease;

(*b*) That the crop has been inspected and that on such inspection Wart Disease was not found to exist; or

(*c*) That the potatoes were inspected while growing and found to be of an approved immune variety true to type and reasonably free from rogues.

Although the Order did not come into operation until 1st June, 1923, it is satisfactory to record that a large number of applications for these certificates was received by the Ministry. The procedure adopted was to issue certificates under (*a*) if an examination of the records in the Ministry's possession showed that no case of Wart Disease had been found in the immediate neighbourhood. Certificates of this category were issued in respect of 58,115 acres. In the case of potatoes grown on land less than 1 mile from a field where Wart Disease has been known to exist, or of potatoes grown in an infected area or in a district on the borders of an infected area, no certificates were issued unless the potatoes were actually examined and found to be free from disease. Where the results of these examinations were satisfactory a certificate under (*b*) was issued. Altogether certificates in this category were issued in respect of 2,900 acres.

The system of insisting on the examination of potato crops grown on the borders of the Wart Disease Infected Area was fully justified by its results. For administrative purposes a district of about 25 to 30 miles in breadth round the borders of the main infected area was treated as a "suspect zone," and no certificates were issued without examination in respect of crops grown in that zone. It was found that in the north-eastern district of Worcester, the disease was more widely prevalent in field crops than had hitherto been suspected, no fewer than 12 fresh cases having been discovered in field crops as a result of inspections in that district. In view of this discovery it has been decided to certify a large portion of Worcestershire as a Wart Disease Infected Area.

The system of crop inspection necessary in order that certificates under category (*c*) may be granted has been in force since 1918. Its institution in that year was due to the necessity of securing an adequate supply of pure stocks of immune varieties

for planting in Wart Disease Infected Areas, in which at that time only immune varieties were allowed to be planted. These restrictions were modified as from the planting season of 1922 by allowing susceptible varieties to be planted in Infected Areas on land where Wart Disease had not been known to exist. This modification, together with the slump which followed the heavy crop of 1922, led to a reduction in the acreage of immune varieties inspected for purity certificates only, and the acreage inspected fell from 6,200 acres in 1921 to 2,300 acres in 1923.

One of the main features in producing a heavy and uniform crop of potatoes is the use of well selected seed, true to type and free from disease. Seed from diseased crops seldom produces satisfactory results, and crops produced from mixed seed ripen unevenly and in many cases prove disappointing. The Ministry has endeavoured by the introduction of the system of certification to secure occupiers of clean land against planting seed which has been grown in soil infected with Wart Disease, and it will be seen from the foregoing that provision has also been made to enable the farmer to obtain seed of immune varieties which is true to type.

Most potato growers realise the importance of planting true stocks of potatoes, and in order to assist growers to meet the demand for such stocks, the Ministry has arranged not only to continue the inspection of growing crops of immune varieties but also to extend the scheme to growing crops of susceptible varieties.

Growers of potatoes, who intend to sell their crops for seed purposes and who desire to avail themselves of the facilities offered by the Ministry for the certification of their growing crops, are requested to make application not later than 21st July. Forms of application may be obtained from the Ministry's offices and should be carefully filled in and forwarded together with a remittance at the rate of 2s. 6d. for every acre or part of an acre to be examined.

Growers who intend to sell their crop for seed, but who do not desire to obtain a purity certificate should not forget that they must apply to the Ministry for a clean land certificate.

It must be remembered that certificates issued under the Wart Disease of Potatoes Order are of two kinds only; they either certify the purity of the crop from rogues or that no Wart Disease is present on the land in which the potatoes were grown. They must not be taken to mean that the seed to which they relate is free from any disease other than Wart Disease. It

should be noted also that any certificates which may be issued by the Ministry as to the purity of crops of susceptible varieties will be of no value for the purposes of the Wart Disease of Potatoes Order. It will be necessary to obtain "clean land" certificates before the crops are sold for planting.

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JULY ON THE FARM.

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Weather Notes.—On the average of long series of seasons, July has the highest mean temperature—about 60° F. in the Midlands—though the hottest day of the year may occur in August or even September. Over the greater part of England the normal night temperature in July does not go below about 53° F., while the normal maximum day temperature is about 70° F. In July the days begin to shorten and normally the duration of bright sunshine is about 20 minutes less per day than in June. In the matter of rainfall, this month is very erratic; on the eastern side of the country it normally measures about 2 in., while in the northern and western districts it averages between 2.5 and 3.5 in. In successive years, however, the precipitation in July may present great contrasts, and, unfortunately, the character of the weather of the preceding months affords no guide as to what rainfall may be expected in this period. The following extracts from records kept by Messrs. Davis & Son show the variations observed at Derby in the last four years:—

	1920 in.	1921 in.	1922 in.	1923 in.	Av. of 1900 to 1920 in.
May	2.85	1.90	0.94	2.63	2.12
June...	2.66	0.42	0.74	0.68	2.13
July	5.23	0.59	3.96	4.37	2.68
August	0.97	5.15	5.15	2.61	2.89

Being the principal hay harvesting month in the grass counties, July pleases best when it brings a period of settled, dry weather. The same conditions favour the arable farmer who has an area of bare fallow, the successful cleaning of which largely depends upon the occurrence of hot rainless weather to dry the clods through and kill the weeds they contain. An unduly prolonged dry period during the time when corn is feeding and maturing the grain, however, is undesirable, and

soil moisture is necessary to allow of the translocation of food materials from the leaves and stem to the apex of the plant: corn does not yield well after premature ripening; but this defect is associated with light rather than medium land. It may be supposed that the heavy rains of May and early June have furnished the soil with all the moisture necessary to complete the growth of corn crops; already there appears to be a tendency towards excess of straw, which much further moisture would cause to lodge; hay crops are very luxuriant and, while roots have come up well, the continuous saturation of the soil during the first half of the season has greatly reduced the cleaning effect of hoeing operations. Undoubtedly a dry July is what most farmers ardently wish for this year.

St. Swithin's.—The common adage is to the effect that as it rains or is fair on 15th July there will be a continuous track of wet or dry weather for the forty days ensuing. St. Swithin, who was Bishop of Winchester, died about A.D. 862, and in accordance with his request he was buried in the churchyard. On 15th July, 971, however, his remains were translated to the interior of the cathedral. It is said, but on doubtful authority, that the popular belief associated with the anniversary of the translation arose from the occurence of a wet period of forty days which commenced on that day. It may be of interest to add that rainfall records lend no support to the popular adage, although the date is very near a well-known bad time in wet years.

Arable Land.—Corn crops usually pass through the milky and the waxy stages of ripening in the month of July, giving the final warning to see that the self-binders are in good order. Winter oats and winter barley often reach technical ripeness—the "ready-to-cut" stage—in this month, but it is only in early districts or exceptional seasons that the harvesting of wheat and spring corn becomes general before August. In many districts, especially near centres of population, sparrows are a serious pest to the corn grower at this time of the year. Some years ago sparrow clubs did good work for a time, but in most cases they ceased to exist when their continuance might have led to a real reduction in the numbers of this very noxious bird. One farmer in Midlothian continued to attend to his sparrow-trap after the local club had become defunct, and showed the writer records of his annual catch, numbering about 400 sparrows each year.

On the bare fallows July is the time for stirring and reducing the clods: earlier refinement of the land usually defeats the object by keeping the soil too moist for the weeds to be killed. Where lime is applied at this stage in the rotation, the horses and labour may best be spared for that work between hay and corn harvests. Pen-fallowing (*i.e.*, breaking up second-year seed layers soon after the removal of the hay crop) is regarded with much favour in certain districts where wheat follows "seeds." By ploughing, immediately after the hay crop has been taken, or after the flush of grass has been consumed in cases where the crop is grazed, time is allowed for a fairly thorough stirring and cleaning of the land before the wheat is sown. Last year the writer noted considerable benefit from the cultivation of a catch crop of mustard grown before the land was sown with wheat.

Work among root crops is now almost limited to shallow horse-hoeing and the filling of gaps, although in some districts the season for root-sowing extends far into July. Where the crops have begun to extend their foliage across the interspaces between the drill rows, care should be exercised in the work of horse-hoeing. The main reason for caution at this stage is not so much to avoid damage to the tops of the crop as to avoid driving the shares of the hoe through the root fibres, from the ends of which the plant feeds. Considerable damage is every year accountable to neglect of this precaution, and there is a certain amount of evidence that the ravages of finger-and-toe disease among swedes and turnips are accentuated by injudicious use of the horse-hoe at this stage. On heavy or wet land, root crops may be lightly earthed up with the double mould-boards after the last stirring: the object of this is to hold the land drier for the harvesting of the crop in November.

Ensilage.—Although haymaking is the principal work in July, farmers who have erected silos will generally complete the filling during the periods when weather considerations prevent progress in the hay fields. During the past few years ensilage has gained considerable favour among arable farmers, and the tower silo is becoming a familiar feature of farm steadings. Tower silos are being made of various materials and perhaps it may be of interest to mention that in the neighbourhood of Worcester there may be seen three silos which were at one time the funnels of an Atlantic liner; these have been in use for a number of years and give good results.

During the 'eighties of last century, when there was a succession of wet summers, considerable attention was paid to the possibility of substituting ensilage for haymaking as a means of securing the produce of meadow land. Favourable reports were published by both of the two principal agricultural societies, and for a time the ensilage of fodder in stacks and rectangular silos was widely practised. With the return of better weather conditions, however, interest in the process subsided, and in the 'nineties ensilage had ceased to be considered as a practical alternative to haymaking in reasonably good weather. The principal objections to the ensilage of grass crops by the methods then tried were the wastage involved, the uncertainty of the product, its smell, and its small market value compared with that of hay.

Modern ensilage practice is concerned less with the hay crop than with the substitution of a part of the root break with a forage crop, generally winter oats and vetches. Naturally it is most attractive to the occupiers of considerable areas of arable land and especially to those who encounter difficulties in dealing with the root break. Ensilage assists in distributing the labour requirement of the farm uniformly over the whole season, which is one of the first principles of economical farm management.

It had been stated by one who has examined the silage made on many farms that bad silage is rarely made in a tower silo. The product does vary, however, according to the temperature attained by the mass during its fermentation. A certain amount of heating in the silo is desirable—to 100° F. or even 120° F. —to ensure which it is essential that the fodder be ensiled alive and not too wet.

Consequent upon the demonstration of the success of the tower silo, interest has revived in other ways of making silage. Mr. A. W. Oldershaw, Agricultural Organiser for East Suffolk, has called attention to the trench method practised for upwards of thirty years by Mr. Wm. Makens, of Colney, Norwich. A trench is opened (in suitably dry ground) about 13 ft. wide, 4 ft. deep, and in length 3 to 4 ft. for each acre of crop to be ensiled. Into this trench the green fodder in its long state is tipped and consolidated, the empty carts being drawn over the mass. The heap is built up to a height of several feet above ground level and a good steep roof is made, steep enough to shed rain after the mass has settled. The ends and sides are trimmed, a topping-up of hedge-side material is put on and the whole

is covered with an 8-in. coat of earth. After the mass has settled, the resulting cracks in the soil-coat are filled in to prevent the entry of air and water.

Pastures.—At the time of writing many pasture fields are running to seed, and generally they carry an excess of growth which in the ordinary course of grazing will not be well utilised. It is a rule of good husbandry that the coarse ungrazed portions of pastures (as well as any thistles) should be mown in July, but it is not always possible to collect and make use of the mowings. A few farmers have recently adopted the Dutch plan of ensiling as much of the produce of the pastures as the cattle appear not to require in the summer. During July and August there are usually many wet days when it is difficult to find productive employment for the men between milking times; at such times the pastures can have the attention here suggested. In the cases where the practice has come to the writer's notice, the pasture mowings have been made into stack silage, the forage being put on from time to time when opportune. The trench method, however, appears most to commend itself for those who have not occasion to build cylindrical pit or tower silos but who desire to avoid the wastage that is almost inevitably associated with the stack method.

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MONTHLY NOTES ON FEEDING STUFFS.

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Mineral Mixtures for Pig Feeding.—It has been demonstrated, both in America and in this country, that the addition of mineral substances to the ration normally fed to pigs is sound practice, particularly when the foods used are all of vegetable origin. It has also been proved at the Rowett Research Institute that a serious condition of mal-nutrition can arise in pigs in the absence of iron in the dietary, and that this condition is quickly alleviated by the addition of small quantities of a simple iron salt. Notes have appeared in this *Journal* from time to time showing that the inclusion of mineral mixtures in pig dietaries is a sound and economical practice. In America much work of a practical character has been carried out on this aspect of nutrition, and a recent bulletin issued from Iowa Agricultural Experiment Station summarises the results of the work of

DESCRIPTION.	Price per Qr. s. d.	Price per Qr. lb.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	—	—	12/-	12 0	0 16	11 4	71·6	3/2	1·70
Barley, Karachi	34/6	400	9/8	9 13	0 12	9 1	71	2/7	1·38
,, Persian	31/6	,,	8/10	8 17	0 12	8 5	71	2/4	1·25
,, Tunisian	32/3	,,	9/-	9 0†	0 12	8 8	71	2/4	1·25
Oats, English, White	—	—	10/4	10 7	0 14	9 13	59·5	3/3	1·74
,, ,, Black and Grey	—	—	10/-	10 0	0 14	9 6	59·5	3/2	1·70
,, Canadian:—									
No. 2 Western	27/-	320	9/5	9 8	0 14	8 14	59·5	2/11	1·56
No. 3 ,,	26/-	,,	9/1	9 2	0 14	8 8	59·5	2/10	1·52
Feed	24/9	,,	8/8	8 13	0 14	7 19	59·5	2/8	1·43
,, Argentine	23/3	,,	8/2	8 3	0 14	7 9	59·5	2/6	1·34
,, Chilian	27/3	,,	9/6	9 10	0 14	8 16	59·5	2/11	1·56
Maize, American	41/6	480	9/8	9 13†	0 13	9 0	81	2/3	1·20
,, Argentine	43/6	,,	10/2	10 3	0 13	9 10	81	2/4	1·25
,, Galatz-Foxanian	43/3	,,	10/2	10 3†	0 13	9 10	81	2/4	1·25
,, Karachi	43/-	,,	10/-	10 0	0 13	9 7	81	2/4	1·25
Beans, English Winter	—	—	11/-	11 0	1 13	9 7	67	2/9	1·47
,, Rangoon	—	—	10/1	10 2†	1 13	8 9	67	2/6	1·34
Peas, Japanese	—	—	22/6	22 10†	1 9	4 1	69	6/1	3·26
Millers' Offals:—									
Bran, British	—	—	—	6 15	1 7	5 8	45	2/5	1·29
,, Broad	—	—	—	8 0	1 7	6 13	45	2/11	1·56
Middlings—									
Fine, Imported	—	—	—	9 7	1 3	8 4	72	2/3	1·20
Coarse, British	—	—	—	8 12	1 3	7 9	64	2/4	1·25
Pollards, Imported	—	—	—	7 0†	1 7	5 13	60	1/11	1·03
Meal, Barley	—	—	—	10 10	0 12	9 18	71	2/9	1·47
,, Maize	—	—	—	11 10	0 13	10 17	81	2/8	1·43
,, ,, Germ	—	—	—	9 2	0 19	8 3	85·3	1/11	1·03
,, ,, Gluten Feed	—	—	—	9 7	1 8	7 19	75·6	2/1	1·12
,, Locust Bean	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
,, Bean	—	—	—	13 0	1 13	11 7	67	3/5	1·83
,, Fish	—	—	—	19 0	4 8	14 12	53	5/6	2·95
Linseed	—	—	—	19 15	1 12	18 3	119	3/1	1·65
,, Cake, English 12% Oil	—	—	—	12 2	1 19	10 3	74	2/9	1·47
,, ,, 10% Oil	—	—	—	11 7	1 19	9 8	74	2/6	1·34
,, ,, 9% Oil	—	—	—	11 5	1 19	9 6	74	2/6	1·34
Cottonseed Cake, English 5½% Oil	—	—	—	8 0	1 16	6 4	42	2/11	1·56
,, ,, Egyptian 5½% Oil	—	—	—	7 15	1 16	5 19	42	2/10	1·52
Decorticated Cotton Seed Meal 7% Oil	—	—	—	12 0†	2 16	9 4	71	2/7	1·38
Coconut Cake 6% Oil	—	—	—	9 12	1 11	8 1	73	2/2	1·16
Palm Kernel Cake 6% Oil	—	—	—	7 2†	1 5	5 17	71·3	1/8	0·89
Feeding Treacle	—	—	—	7 7	0 8	6 19	51	2/9	1·47
Brewers' Grains:—									
Dried Ale	—	—	—	6 10	1 5	5 5	49	2/2	1·16
,, Porter	—	—	—	6 2	1 5	4 17	49	2/-	1·07
Wet Ale	—	—	—	1 3	0 9	0 14	15	-/11	0·50
,, Porter	—	—	—	0 17	0 9	0 8	15	-/6	0·27
Malt Culms	—	—	—	8 0†	1 15	6 5	43	2/11	1·5

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s. 6d.; P_2O_5, 4s. 1d.; K_2O, 2s. 6d.

Professor Evvard and his co-workers on this subject. These workers have shown that a simple mixture of wood ashes and salt gives good results in practice. Wood ashes are deficient in sodium, chlorine, phosphorus and iodine, and a wood ash mixture should therefore contain common salt, potassium iodide, and steamed bone flour or bone phosphate to supply these deficiencies. It has also been shown that the addition of charcoal, sulphur, calcium and iron is sometimes desirable. The following three mixtures have been shown to give good results in practice, No. 2 being of a laxative character :—

(1)	Hard wood ashes ...	52 lb.	Common salt	15 lb.
	Bone charcoal ...	25 „	Potassium iodide ...	.02 „
(2)	Hard wood ashes ...	52 „	Glauber's salts ...	4 „
	Bone charcoal ...	25 „	Epsom salts	2 „
	Common salt ...	12 „	Copperas	2 „
	Flours of sulphur ...	3 „	Potassium iodide ...	.02 „
(3)	Common salt ...	20 „	Bone charcoal	40 „
	Finely ground limestone or chalk ...	40 „	Potassium iodide ...	.05 „

The main points emphasised in American practice are as follows :—

(1) Common salt is of major importance in building up a good mineral mixture: salt is essential for *all classes* of stock.

(2) There is no mineral mixture which can be regarded as the best for all conditions of feeding. Many good mineral mixtures can be compounded, but it is wise to bear in mind in compounding a mineral mixture that the following elements should be included :—Sodium and chlorine—as in common salt; calcium—as in high-grade limestone or chalk; wood ashes; phosphorus—as in bone products; and iodine—as in potassium iodide.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·20	2 3	71·6	8 1	0 16	8 17
Oats	1·20	2 3	59·5	6 14	0 14	7 8
Barley	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes	1·20	2 3	18·0	2 1	0 4	2 5
Swedes	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds	1·20	2 3	6·0	0 14	0 3	0 17
Good Meadow Hay	1·16	2 2	31·0	3 7	0 14	4 1
Good Oat Straw	1·16	2 2	17·0	1 17	0 7	2 4
Good Clover Hay	1·16	2 2	32·0	3 9	1 1	4 10
Vetch and Oat Silage	1·16	2 2	14·0	1 10	0 7	1 17

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	*Average Price per ton during week ending June 18th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	..	13.12	14. 0	18. 1
" " Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N. 20¾ per cent.)	14. 2*	14. 2*	14. 2*	14 2.*	(N)13. 7
" " " neutral (N. 21¼ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5
Kainit (Pot. 12½ per cent.)	...	..	...	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
" " (Pot. 20 per cent.) ...	...	2.10	...	2.17	2.10
Potash Salts (Pot. 30 per cent.) ..	...	..	...	3.15	2. 6
" " (Pot. 20 per cent.)	...	...	2.10	2.15	2. 9
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7.10	3. 0
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 30 per cent.) ...	...	..	2.12§	...	...
" " (T.P. 28 per cent.) ..	...	2. 1‡	...	...	...
" " (T.P. 26 per cent.)	...	1.14‡	...	.	...
" " (T.P. 24 per cent.) ...	...	1.11‡	2. 0§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.10	2. 0
" (S.P. 30 per cent.) ...	3.16	3. 7	3. 8§	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8.10	7.15	.
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	6.15†	6. 0	6. 2†	...
Fish Guano (N. 7½-8¼, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
" " (N. 9, T.P. 10 per cent.) ..	...	...	...	13.10	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.
† Delivered (within a limited area) at purchaser's nearest railway station.
‡ F.o.r. Works.
§ Prices include cost of carriage from works to town named.

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World's Poultry Congress.

THE second World's Poultry Congress took place at Barcelona and Madrid from 9th-19th May, twenty-five countries being represented. The proceedings were attended by over 60 representatives from this country. Most of the British representatives left Victoria Station on the morning of 7th May and were accompanied by a number of American and Canadian representatives.

The Congress was formally opened in the Grand Hall of the University of Barcelona, on 10th May, by His Excellency the

Sub-Secretary of Agriculture, in the presence of State Officials (Civil, Military and Naval), the Mayor and Corporation of Barcelona, the Consular Corps, the official delegates to the Congress from all the countries concerned, and a large company of visitors. In responding to the official address of welcome by the Secretary-General of the Congress, Mr. Edward Brown (Joint President of the Congress with Professor Salvador Castéllo) called attention to the fact that several of the most valuable breeds of poultry had originated in Spain. It was Spain also that had introduced the turkey to Europe. Although Spain had for a long period given attention to poultry breeding, other European countries had perhaps made more rapid advances during the last half-century, owing no doubt to the impulse of industrial and commercial developments, and to vast increases in the human population. They who were from those other European countries had come to repay something of their indebtedness to Spain, to lay before her their experience and to learn what she had to teach.

It was the object of these international poultry congresses to gather into one focus all the best of the knowledge and experience that had been gained by the workers in the industry in all countries, so that it might be disseminated for the benefit of all, instead of being more or less buried; and to find out how far each country's problems had been met with or solved in other countries.

Mr. Brown also pointed out that the universality of poultry breeding and production was one of its most striking characteristics. In relation to food supplies, poultry had been for centuries merely a side issue, primarily to meet household needs. Under such circumstances little attention would be given to the breeding qualities and productive capacity of the stock, to true economy in housing and feeding, to marketing produce on the best lines and to the prevention of disease. A fundamental change had, however, taken place within recent years, most of all in Western Europe, North America, Australia and New Zealand, where commercial egg and table poultry production had shown itself to be an economic success.

An impressive speech made at the first meeting of the Congress by Prof. Don Salvador Castello, who was the Spanish organiser of the Congress and Exhibition, concluded as follows:—

"I must thank the press for the assistance rendered to the Executive Committee and to me personally during

the past thirty years, during which I have employed all my activities in speaking in capital cities, towns and insignificant villages of the advantages of poultry breeding as an inexhaustible fountain of rural riches. The hour has arrived to say to all Spain: See what I have preached; see here assembled the great World's Exhibition of Aviculture, the crystallisation of what is done in the most advanced countries. The lands beckon us to follow their example, and if we do so we shall make such progress in Spanish poultry production as not only to maintain but improve the creditable position which we have already achieved in this World's Second Congress and Exhibition."

The following Resolution, which was adopted by the Congress, directed attention to the establishment of a National Poultry Institute in England:—

"That it is desirable that Aviculture Research Institutes, similar to that described in the paper contributed by Mr. H. E. Dale, of the English Ministry of Agriculture, should be established in all countries."

It is hoped that translations in English of the various papers read at the Congress will be obtainable in due course. Individuals desiring copies of these papers should make application to the Hon. Secretaries, Second World's Poultry Congress Committee, 3, Vincent Square, Westminster, S.W.1.

With regard to the Exhibition, which was opened at Barcelona on Saturday, 10th May, and closed in the evening of Sunday, 18th May, there is no doubt whatever that this was a great success. The exhibits filled a large hall (approximating in size to that of the Main Hall at Olympia), which was beautifully decorated in the true Spanish style. Over 120,000 people visited the Exhibition, which was divided into sections for the grouping of the exhibits received from each of the countries represented. Large sections of the hall were taken by Holland, Italy, France, Canada, the United States, Denmark, Czecho-Slovakia, Belgium, Spain and Great Britain. It is impossible to give here a detailed description of each country's exhibits. It must suffice to say that each country represented made a good display. The British exhibit comprised some 83 pens of birds (usually three in a pen). All the fowls looked very well after their long journey. The British list of exhibitors was headed by H.R.H. the Prince of Wales, whose White Wyandottes, Rhode Island Reds and Australorps were penned near to the exhibits from the Queens of Spain and Belgium. It was

generally agreed that the British Section, as a whole, stood easily first both in point of numbers and quality, and it was easy to trace English blood in the exhibits of some other countries. The educational and scientific exhibits in the British Section attracted a good deal of interest, especially when it is remembered that these were the outcome of individual effort as compared with the State-supported exhibits of other countries.

Professor Punnett's exhibit of specimens illustrating the principles of sex-linked inheritance in poultry breeding, which were supported by some stuffed specimens (lent by the Ministry) of adult birds and chicks, attracted much interest. The meaning of these exhibits was made clear by letterpress in Spanish as well as English The Hon. Florence Amherst contributed a display of specimen eggs of most of the breeds of British poultry, which were attractively set out in cases. These were supported by small cardboard models of the breeds which laid the eggs shown. These models were lent by *The Feathered World.* A collection of photographs on poultry subjects and model poultry houses was contributed by Harper Adams Agricultural College.

An interesting exhibit received from Dr. Crew, of Edinburgh University, included some photographs of an abnormal hen during its process of assuming male characteristics. Doctors Plimmer and Rosedale, of St. Thomas's Hospital, London, sent exhibits showing how essential food factors influence the colour of the yolk in an egg, and how the lack of these essential factors influence the resulting chick. A display of illustrations of British breeds of poultry, produced by *The Feathered World* added a welcome touch of colour to the exhibit.

The Congress decided to accept an invitation from Canada to hold the next World's Poultry Congress at Ottawa, Canada, in 1927.

* * * * * *

Firewood: A Rural Industry.

THE Rural Industries Intelligence Bureau has recently issued a leaflet* dealing with Bundled Firewood Manufacture, the object being to encourage the firewood business in rural districts. It is pointed out that the industry, if properly carried out with up-to-date appliances, "can be quite a reasonably profitable undertaking, not only for the small worker, but also by no means beneath the notice of the estate owner or agent, as a useful means of dealing with otherwise almost valueless small timber, tops and thinnings on his property."

* Leaflet No. 12 (*Bundled Firewood Manufacture*).

"While it can be said with a fair amount of truth that in this business 'All is grist that comes to the mill,' there are nevertheless many interesting and several important peculiarities in the combustive properties of different species of woods which render them more or less suitable either for burning simply as fuel, or for splitting up for bundle wood. The requirements for the two cases are not the same, and what is good for the former purpose is not necessarily ideal for the latter. A few remarks therefore on differences of behaviour of some of the better-known varieties will not be out of place here."

"There is much difference of opinion in regard to the respective merits of various home-grown timbers when used for firewood. The age and quality of wood has, of course, a great deal to do with its capacity for heat production, old slow-grown and thoroughly seasoned timber having much greater lasting and heating value than young and sappy growths with a comparatively small amount of heart wood."

"Roughly speaking, the heat value of wood is more or less according to its hardness. Those kinds which burn slowly, evenly and quietly, eventually produce the greatest amount of heat, and are consequently most suited to be used as fuel for heating purposes; while the soft woods generally, and those which crackle and emit sparks during combustion, burn rapidly, developing an intense heat of short duration, and are therefore rather wasteful as fuel, except for special purposes. For instance, fuel of this latter kind was formerly used in the pottery and glass trades and for bakers' ovens. These woods are specially suited for bundle-wood manufacture, although their value for sustained heating effect is generally low."

"Woods much given to sparking are not as a rule desirable as fuel, though in other respects they may be quite suitable. There are some species of woods indeed which burn with almost explosive violence, throwing out dangerous showers of sparks and glowing fragments, but these are not to be found amongst English varieties. Examples of woods which are, however, liable to sparking are resinous pinewoods, cedar, spruce, silver firs, also, to some extent, hawthorn and ash."

"For the purposes of the firewood bundler, with whom this pamphlet is mainly concerned, the foregoing peculiarities are not of great importance, and there are very few woods which can be said to be really unfitted for this purpose, though some of course are better than others. The principal requirements

are that the wood shall be easily cut and split and quick burning, and on this account soft woods are preferable to hard. Liability to sparking is no serious disadvantage, as fires are presumably under observation while the kindling is being consumed, and smell and smoke, pleasant or otherwise, are matters of indifference."

"One or two special points may be alluded to. Oak splits easily but is slow burning, and is better not used for bundling unless obtainable in the form of trade waste, such as well-seasoned ship timber, old barrel-staves, etc. Amongst distinctly unsuitable woods may be mentioned privet, lilac, blackthorn, on account of their hardness, and elm on account of its cross grain as well as its slow-burning propensities. Poplar and non-resinous larch, especially when not thoroughly seasoned, are poor combustibles."

After giving examples dealing more fully with various species of woods which may be used for firewood, the leaflet considers storing, drying and seasoning; methods of obtaining supplies; pit props and trade waste; equipment (saws, engines, bundling machines); chopping; prices; costs of production; and several other matters of importance relative to the starting of a firewood business. A copy of the leaflet may be obtained from The Secretary, Rural Industries Intelligence Bureau, 258-262, Westminster Bridge Road, London, S.E.1.

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Railway Fires Acts.

THE Railway Fires Act, 1905, as amended by the Railway Fires Act (1905) Amendment Act, 1923, provides that, when damage is caused to agricultural land or to agricultural crops by fire arising from sparks or cinders emitted from any locomotive engine used on a railway, the fact that the engine was used under statutory powers shall not affect liability in an action for such damage, but this provision does not apply in the case of any action for damage in which the claim for damage in the action exceeds £200.

The expression "agricultural land" includes arable and meadow land and ground used for pastoral purposes or for market or nursery gardens, and plantations, woods and orchards, and also includes any fences on such land, but does not include any moorland or buildings; and the expression, "agricultural crops" includes any crops on agricultural land, whether growing or severed, which are not led or stacked.

Section 2 provides that a railway company may enter on any land and do all things reasonably necessary for the purpose of extinguishing or arresting the spread of any fire caused by sparks or cinders emitted from any locomotive engine.

It also provides that a railway company may, for the purpose of preventing or diminishing the risk of fire in a plantation, wood, or orchard, enter upon any part of the plantation, wood, or orchard, or on any land adjoining thereto, and cut down and clear away any undergrowth, and take any other precautions reasonably necessary for the purpose; but they must not, without the consent of the owner, cut down or injure any trees, bushes or shrubs.

A railway company exercising powers under this section must pay full compensation to any person injuriously affected by the exercise of those powers, including compensation in respect of loss of amenity.

The Act does not apply in the case of any action for damage by fire brought against any railway company unless (1) notice in writing of the fire having occurred and of intention to claim in respect thereof shall have been sent to the said railway company within seven days of the occurrence of the damage; and (2) particulars in writing of the damage showing the amount of the claim in money not exceeding the said sum of two hundred pounds shall have been sent to the said railway company within twenty-one days of the occurrence of the damage.

Light railways and tramways worked by steam power are within the scope of the Act.

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Instruction in Clean Milk Production in Berkshire.

THERE is an unusual number of farmers in Berkshire who are licensed for the production of "Certified" and "Grade A" milk, or who are endeavouring to produce milk of similar standard. This is no doubt due to the location in the county of the National Institute for Research in Dairying. The Berkshire County Agricultural Instruction Committee, with a view to promoting the further adoption of improved methods, recently instituted a series of 10 demonstrations in clean milk production at certain licensed farms in the county, farmers and their herdsmen in the vicinity being invited to attend.

A representative of the National Institute for Research in Dairying and the County Instructress were present to explain

the whole process of Clean Milk Production at these demonstrations, which were conducted on lines advocated by the Ministry. After the visitors had been shown the cowsheds and dairy, the preliminary operation of grooming the cows and washing their udders and flanks was carried out. The milkers then washed their hands and put on the special coats and caps before milking the cows. Covered pails were used, and as each cow was milked the milk was poured into the carrying pails, taken direct to the cooler, strained and run into 10-gallon milk churns. The churns when filled were sealed and the milk placed on a lorry for transport. Directly the operation was completed all utensils were thoroughly cleaned by washing and steaming.

Great interest was shown at each of the demonstrations, the audiences being able to see the actual methods employed at the licensed farms. As many as thirty farmers with their men attended some of the meetings.

It was thought desirable to point out that model buildings of elaborate design are not essential for the production of clean milk, and one demonstration was given, therefore, at the old farm buildings of the National Institute for Research in Dairying. It was shown there that it is the methods employed and not expensive buildings that are essential for the production of clean milk.

As a result of the demonstrations a clean milk competition has recently been held for herdsmen, whose interest, no less than that of the farmers, must be evoked, if success is to be achieved.

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Conference on Plant Disease Legislation.

THE Ministry of Agriculture and Fisheries is taking advantage of the presence in England this summer of a number of Dominion botanists and mycologists to hold a conference affording an opportunity for a free and open discussion between members of the British Empire of the scientific principles which should underlie legislation regulating the import of plants and plant products.

The Council of the Surveyors' Institution have kindly offered the use of the Lecture Hall at 12, Great George Street, Westminster, and the conference will be held there on Thursday, the 17th July, commencing at 11 a.m.

The presence of scientists, nurserymen and other persons interested in the subject will be welcomed.

Examination and Certification of Apiaries.

IN order both to protect purchasers of stocks of bees and to effect an improvement in the health standard of bees, the Ministry of Agriculture and Fisheries has made arrangements for the inspection, on application, of apiaries where bees are raised for sale. Where no brood diseases are found to be present in an apiary, an official certificate to that effect will be issued. For the present it will not be possible to include Acarine disease in the scheme, and the certificates will relate solely to freedom from brood diseases, though they will not be issued for apiaries where Acarine disease is seen to be present. The frames containing the combs of the colonies that are passed on inspection will be impressed with a metal stamp with the date of inspection, and this will afford protection to the purchaser. Owners of apiaries where bees are raised for sale are invited to make early application for inspection. All applications should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. Fees at the rate of £2 2s. per day, with a minimum of £1 1s., will be charged for this service.

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Export of Boars to Rumania.

THE Commercial Secretary of the British Legation at Bucarest states that an extraordinary credit has been placed at the disposal of the Rumanian Ministry of Agriculture and Domains for the purpose of purchasing bulls, rams and boars for breeding purposes.

There would appear to be no opening for British bulls and rams, but there is every prospect that the departmental commissions would approve purchases of British boars. Any breeders in this country wishing to sell boars to Rumania should send their offers direct to the Ministry of Agriculture and Domains, Direction Zootechnica, Bucarest.

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Poultry-Keeping Scholarships.

THE Ministry has approved a proposal of the Durham County Council to award scholarships in poultry-keeping tenable at the County Poultry Station at Houghall, and will aid expenditure thereon under the Education Grant Regulations up to a maximum of £90 in the current financial year. These scholarships will be of 12 weeks' duration, and the number of awards will probably be six annually (value not exceeding 25s. each per week, to cover tuition, board and lodging).

Scholarship holders will be under the direct control of the poultryman at the Station, and he will be responsible, under the supervision of the County Poultry Instructor, for their practical training. Lectures and theoretical instruction will be given by the Poultry Instructor on three days a week, and as wide a range of subjects as possible will be covered in the 72 lectures which it is proposed to deliver during each course, which will include incubation, rearing, breeding, feeding, housing, diseases and book-keeping.

It is the Authority's intention that practical and theoretical knowledge shall be combined in the course in such a way that the scholarship holders will gain a sound knowledge of the principles underlying successful poultry-keeping.

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Foot-and-Mouth Disease.—The position has undergone considerable fluctuations since the June issue of the *Journal*. The outbreaks for the week ended 25th May fell to 8, and during the following week no outbreak occurred in any part of the country. During the week ended 8th June, however, 5 outbreaks were confirmed, of which 1 was in Kent in a free area, 1 in Northants, and 3 in Notts. The Northants and Notts outbreaks necessitated extensions of the respective infected areas in which the cases occurred.

During the week ended 15th June, 10 outbreaks occurred, the counties involved being: Berks (1), Derby (2), Northants (2), Notts (3), Oxford (1), and Yorks E.R. (1). Of these the outbreaks at Iffley, Oxon, on 10th June, and Halsham, Yorks E.R., on 12th June, occurred in new areas, while extensions of areas were necessitated by the outbreaks in Berks and Derby. During the week ended 22nd June, 17 outbreaks occurred including 8 in Surrey, and involving a new district.

The total number of outbreaks from the 27th August, 1923, to 22nd June, 1924, is 3,127, involving 41 counties in England, 2 in Wales, and 12 in Scotland, and the slaughter of 104,760 cattle, 43,856 sheep, 48,485 pigs, and 129 goats. The gross amount payable in compensation for these animals is £3,342,000, and the receipts in respect of the salvage of healthy carcasses amounts to £495,000.

Importation of Plants into Canada by means of the Parcel Post.—The Ministry desires to inform exporters of plants that the Canadian Authorities have withdrawn the prohibition placed on the importation of nursery stock through the mails. Small parcels of plants, bulbs, etc., may now be sent to Canada by the parcel post, each parcel being accompanied by the usual official certificate of health issued in the country of origin. The consignment will also be examined at the port of entry (Vancouver or Montreal).

The Canadian importer must first obtain an import permit in the usual manner, and indicate that he desires to import by means of the parcel post. Special labels will be furnished to the applicant, who should send them to the exporter to be affixed to the packages, together with the copy certificate of health. Exporters are recommended to

place inside the package an additional label indicating the address of the consignee.

Small consignments of plants to be sent to Canada by parcel post can be examined at the Ministry's office, 10, Whitehall Place. A fee of 1s., payable in advance, is charged, and the following procedure must be followed:—The plants must be sent to the office of the Ministry in a box which can easily be opened, and packed in such a way that they can be taken out and thoroughly examined and then repacked by the inspector. The box must be labelled "Plants (bulbs or seeds) for export." The necessary labels, prepaid, and directed to the Canadian address, must be enclosed, *together with the Customs declaration required by the postal regulations.* After examination the parcel will be posted, and a receipt of posting obtained and sent to the consignor. If it be desired that the parcel shall be insured, the requisite sum must be forwarded. Parcels should, where possible, reach the Ministry at least a week before the departure of the mail.

Establishing a Tuberculosis-Free Dairy Herd.—With reference to the fifth paragraph on page 147 of this *Journal* for May, 1924, in the article by S.E.B. dealing with the Establishment of a Tuberculosis-Free Dairy Herd, results of the cod liver oil method of calf rearing have now been obtained.

On 15th May, 1924, 35 calves (average age 9.31 months) were tested. 24 of these calves had been reared on the cod liver oil method, and 11 on the Grade "A" method. All 35 calves satisfactorily passed the test.

Leaflets issued by the Ministry—Since the date of the list given on page 303 of the June issue of the *Journal*, the following leaflets have been issued:—

New—No. 37. Bean Aphis.

Revised—No. 195. American Gooseberry Mildew.

Amended—No. 23. Potato disease (Blight) and its Prevention.

Feeding Trials with Silage.—Regarding the article on "Feeding Trials with Silage," which appeared in the *Journal* for April, 1924, page 50, objection has been made that the results of the experiments tabulated therein are at variance with those obtained in previous trials. It should be explained, therefore, that the author of a signed article in the Ministry's *Journal* is solely responsible for the statements made in it. It will be obvious that in experimental work in any branch of agriculture the results obtained by different investigators and the conclusions drawn by them may differ, but it may nevertheless be desirable to publish the results as matters of interest.

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QUESTIONS IN PARLIAMENT.

Hop Control.—In reply to a question asked in the House of Commons on 30th May by Viscount Wolmer, as to whether it is proposed to extend the hop control beyond the date of its lapse, 16th August, 1925; and whether to do so would require legislation, Mr. Noel Buxton, Minister of Agriculture, replied: "I am giving careful consideration to the organisation of the hop industry in view of the termination of the present period of control in August, 1925, but I am not yet in a position to make any statement on the subject. The reply to the last part is in the affirmative."

Insolvencies among Farmers—Mrs. Philipson asked the Minister of Agriculture in the House of Commons on 26th May, what is the information in detail upon which the statement is made in the current (May) number of the Official Journal of the Ministry (page 132), that, as regards the number of cases of public insolvency occurring amongst farmers, the pasture areas have suffered more than the arable areas; what are the areas to which he refers; what is the number of the insolvent farmers and the years, and whether, in point of fact, the Ministry, or the author of the statement, in arriving at the above conclusion, was aware of the actual character of the farming operations carried on by the said insolvent farmers?

Mr. Buxton replied that he was informed by the author of the article, who was solely responsible for the views expressed therein, that the statement referred to was based on the geographical distribution of the receiving orders in bankruptcy in the case of farmers in 1922. The number of receiving orders was 287. Of these cases 108, or 37 per cent. only were in the eastern half of England, which, on the whole, is more distinctively arable than the western half. With regard to the last part of the question, the records of public insolvencies do not include any information as to the character of the farming.

Wages, Scotland.—Mr. D. Millar asked the Secretary for Scotland in the House of Commons on 16th April, in how many districts in Scotland agreements had been entered into between the farmers' unions and the farm servants fixing the current rate of wages for agricultural workers; and whether he could specify the rate of wages paid for each grade of worker in each district?

Mr. Adamson replied:—" According to information furnished by the Scottish Farm Servants' Union, I understand that agreements were made at the recent hirings in the Lothians and in the Glasgow district, which includes Dumbarton, West Stirling, Lower Lanark and Renfrew. The terms agreed on are as follow:—

East Lothian.—An increase in wages of 1s. per week for all men and women employed on the farms, and a bonus of 26s. to be payable to all men on the farms, in the event of the average fiars' prices for wheat, oats and barley for 1925 exceeding the average fiars' prices for these grains for the year 1924. This brings the standard for ordinary married ploughmen to 34s. per week, with 16 cwt. of potatoes in the year and house rent free. First men are paid 1s. per week more. Grieves, cattlemen and herds usually receive higher rates, but these vary according to size of farm, etc., and it is not possible to state any standard figure. Women's wages are 21s. per week.

Midlothian and West Lothian.—An increase in wages of 1s. per per week for men and 6d. for women. This brings the standard rate for ordinary married ploughmen to 35s. to 39s. per week, with 12 cwt. of potatoes in the year and house rent free. First men are paid 1s. per week more; the rates for grieves, cattlemen and herds vary as in East Lothian. Wages for women workers range from 19s. to 20s. per week.

Glasgow District.—An increase in wages of 1s. per week to all male married workers. This brings the standard rate to 38s. to 40s., per. week, with six cwt. of potatoes and 10 stone of meal in the six months and house rent free. First men receive 1s. per week more."

Agricultural Workers' Wages (Europe).—Mr. Briscoe asked the Minister of Agriculture in the House of Commons on 6th June, whether he had any information showing which are the countries in Europe where wages of agricultural workers are regulated; and would he state whether it is by the State, and what the regulated wages are?

Mr. Buxton replied that in a number of countries in Europe the wages of agricultural workers are regulated under some system of State control. In Hungary and Esthonia the machinery appears to resemble the Trade Board system in existence in this country. He was circulating in the Official Report such information with regard to the various countries as was in his possession. He had no definite information as to the current rates of wages.

Following is the information:—

"The following is a summary of such information with regard to the regulation of agricultural wages in Europe as is in the possession of my Department. The particulars have been collected from various sources, and must not be taken as necessarily complete.

Austria.—In the absence of collective or individual wage contracts, wages must not be less than permanent statutory minima fixed by law.

Belgium.—Individual bargaining is the general rule, with provision for appeal to board of arbitrators. In certain provinces, the decisions of the arbitration boards have force of law.

Czechoslovakia.—Collective agreements (which must be registered with the State Labour Department) must be based on a scheme of labour conditions and scale of wages drawn up annually by the Agricultural Department of the Ministry of Labour. Disputes are referred to joint committees and, if necessary, to arbitration courts.

Denmark.—Wages boards consisting of three conciliators are charged with the duty of administering agreements reached between employers' and workers' organisations. In the event of a dispute the matter is referred to the Permanent Arbitration Court, whose findings have the force of law.

Esthonia.—Provincial Joint Committees meet every year for the purpose of considering minimum rates of wages and the hours of work, their proposals being submitted to the Ministry of Labour, which communicates them to the National Joint Committee. The National Committee examines and co-ordinates the proposals of the provincial committees, which are then, if approved by the Ministry of Labour, published, and assume the force of law.

France.—As in Belgium, individual bargaining prevails throughout the country. Conciliation committees act in cases of dispute.

Germany.—Conciliation boards exist to solve difficulties arising out of collective agreements.

Hungary.—Under an Act passed last year, a system is to be established for the fixing of agricultural wages by district committees (comprising representatives of both sides, and an independent president and vice-president). The rates fixed will be enforceable by law. Pending organisation of the new system, the Act empowers the Minister of Agriculture to fix a minimum rate for 1923 and 1924.

Italy.—Conciliation committees are believed to exist for the settlement of disputes.

Netherlands.—Provision is made for conciliation in cases of disputes affecting 50 or more workers.

Norway.—Settlement of disputes rests with industrial courts.

Poland.—Disputes arising out of collective agreements are dealt with by joint conciliation and arbitration committees. As a temporary measure, a special arbitration Board was set up in 1921 with power to fix wages and working conditions of agricultural labour, and this board has continued to function up to the present.

Sweden.—Machinery has been established for arranging of collective agreement. Any disputes are referred to a central arbitration court, whose decisions are enforceable by the organisations concerned."

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REPLIES TO CORRESPONDENTS.

Millipedes.—H.P. enquired the cause of certain damage to celery grown in a greenhouse.

Reply: The specimen is rather small but there are upon it quite sufficient millipedes (*Julus pulchellus*) to account for the damage. Damage by millipedes is not infrequently combined with that of slugs, which are, of course, very troublesome as regards celery. As a rule, the presence of millipedes in such quantity betrays a high content of vegetable humus in the soil. The Ministry's leaflet No. 94, Millipedes and Centipedes, gives some details of life history and suggestions for control.

Dissolving Bones.—K.N. asks how to dissolve bones for manure.

Reply: From old references to the matter it would appear that farmers used to be in the habit of purchasing inch-bones and treating them with sulphuric acid. The bones were placed within a ring of ashes, and after moistening them with water the acid was poured over them and the mass was then stirred with rakes until every fragment of bone was brought into contact with the acid. They were then mixed with the ashes and left in a heap to dry. It will be noticed that in this case the bones had to be broken first. The process is said to have been somewhat awkward and even dangerous. Consequently preference is now given to bones which have been dissolved in properly equipped factories On the processes there adopted such books as Collins' "Chemical Fertilisers" and Fritsch's "The Manufacture of Chemical Manures" might be consulted.

Indoor Cow-keeping.—L.C. inquires as to keeping cows in stalls all the year round and feeding entirely on bought produce.

Reply: The Ministry is not aware of any herd, outside the towns, which lives "practically entirely on bought produce." Did such exist, it could scarcely be characterised in terms of number of cows kept per acre, as practically no acreage of farm-land would be required for its support. It may be mentioned that when cows are kept on the soiling system, one acre will suffice for two to three cows.

As to the question whether, assuming it to be profitable to purchase all food for a 1,000 gallon cow, any land is necessary for the keeping of cows, the answer is probably to be sought in the practice of the industry. If the method were promising from a money-making point of view it would probably have already been tried all over the country. But the cows would doubtless soon deteriorate and wear out as they do in town dairies.

Grub on Chrysanthemum Leaves.—H.P.W. enclosed young chrysanthemum leaves showing a "blight."

Reply: The insect attacking the chrysanthemum leaves is the grub of a small fly, *Phytomyza chrysanthemi*. This grub or larva lives between the layers of the leaf, making tunnels and feeding upon the tissue. The best remedy to apply is to pick off by hand and destroy the attacked leaves on the very first indication of attack. This will generally prevent further trouble. If the attack once gets a hold on the plants when they have become a fair size, it is extremely difficult to control. A very strong solution of nicotine and soap is then the only remedy. Its effect, however, is sometimes doubtful, and it is also expensive to apply, so that checking the attack in the early stages by the removal of the leaves as indicated is quite the best manner of dealing with the pest.

Vine Scale.—J.H.R. forwarded specimens of a pest which was ruining a vine.

Reply: The pest is the vine scale (*Pulvinaria vitis*), a coccid which occurs not uncommonly on vines both under glass and also out of doors in sheltered places. This can be controlled by spraying or washing the vines thoroughly with paraffin emulsion at the time when the plants are dormant. Other insecticides, such as lime-sulphur, would also prove effective. The Ministry's leaflet No. 352 (Control of Pests of Fruit Trees in Gardens and Small Orchards) gives instructions for making a number of washes, including lime-sulphur.

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ADDITIONS TO THE LIBRARY.

[Readers of the *Journal* who are not aware that certain books and agricultural periodicals may be borrowed from the Ministry's Library should write for particulars and conditions of loan.]

Agriculture, General and Miscellaneous.

Watson, J. A. S., and *More, J. A.*—Agriculture: The Science and Practice of British Farming. (666 pp. + xxx plates.) Edinburgh and London: Oliver & Boyd, 1924, 15s. net. [63(022).]

Bear, F. E.—Soil Management. (274 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 10s. net. [63.11(02).]

International Institute of Agriculture.—Production et Consommation des Engrais Chimiques dans le Monde. 3rd edition. (266 pp. + 99 charts.) Rome, 1924. Fr. 25. [63.1621.]

International Institute of Agriculture.—Les Offices de Comptabilité Agricole dans les Divers Pays. (529 pp.) Rome, 1924, Fr. 50. [657.]

Canada Advisory Council for Scientific and Industrial Research.—Bulletin 11:—Nitrogen Fixation. (28 pp.) Ottawa, 1924. [668.6.]

Field Crops.

Welsh Plant Breeding Station.—Series H, No. 3, Seasons 1920-23:—Further Investigations with Herbage Plants:—

I. Seasonal Productivity of Herbage Grasses, *R. G. Stapledon.*

II. The Nutritive Value of Grasses as shown by their Chemical Composition, *T. W. Fagan* and *H. T. Jones.*

III. Productivity of Different Strains and Nationalities of Red Clover, *R. D. Williams.*

IV. A Note on Subterranean Clover, *R. D. Williams* and *W. Davies.*

V. Grassland and the Grazing Animal, *R. G. Stapledon, T. W. Fagan* and *R. D. Williams.*

(168 pp.) Aberystwyth: University College of Wales, 1924, 12s. 6d. [63.33.]

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NOTES FOR THE MONTH.

Co-operation and Credit: Government Assistance.

In a speech made in the House of Commons on 12th February last, the Prime Minister made the following statement: "The Government propose to support, either by loans or by guarantees, co-operative enterprises *controlled* by the agricultural community, organised and directed mainly to deal with agricultural produce, the buying of the raw materials, seeds, manure, the buying of implements of cultivation, the supplying of markets, and all those processes necessary to make agriculture a paying and prosperous concern in this country."

There are three directions in which steps have been taken to render assistance to agricultural co-operative enterprises in this matter: (*a*) through the Agricultural Credits Act for the supply of credit, (*b*) by means of loans to agricultural co-operative enterprises, and (*c*) by guarantees to larger agricultural organisations under the Trade Facilities Acts.

Agricultural Credit Societies.—The Agricultural Credits Act was passed in August, 1923, and on the initiation of the scheme the rate of interest on loans was fixed at 5 per cent. This made it necessary for Societies to charge 6 per cent. to borrowers, and it appeared likely that this would prove a serious obstacle to the success of the movement. The rate of interest was reduced in March of this year to current Bank rate with a minimum of 4 per cent., so that this obstacle has now been removed.

The Act provides facilities which enable farmers, small holders, allotment holders, and other agriculturists to obtain credit to meet such expenses as the purchase of seeds, fertilisers, feeding stuffs, the purchase of breeding and other live stock, of machinery and implements, the erection of silos, barns, fencing, etc., the purchase of fruit trees, etc.

(56051) P.6./R.4. 8,500. 8/24. M. & S. A

A leaflet* has been issued explaining the method of forming societies, and if the scheme outlined in the leaflet is taken up it should prove of great advantage to small farmers and others in enabling them to purchase live stock and requirements on extended credit. It is not usually practicable or desirable for a society to be formed exclusively of prospective borrowers, and the method suggested in the leaflet is that such societies can best be promoted through the agency of existing co-operative societies or other organisations, who will take up shares in the Credit Societies without being actual borrowers. Under such an arrangement the share capital subscribed by the co-operative society, or other organisation, combined with the shares taken up by prospective borrowers and with the proportionate Government advance, would put the society on a sound footing.

The advantage of combining a Credit Society with a Co-operative Trading Society is that the loan and the purchase can be made through the same channels at the same time. The object of the loan in the majority of instances will be to enable the borrower to purchase agricultural requisites such as fertilisers, seeds, live stock, implements, etc., and the natural course is to adapt the scheme to the ordinary conditions of agricultural trade in which credit plays a very large part. The adoption of the above proposal by Co-operative Trading Societies would be to the benefit of those farmers and small holders who wished to make purchases on a system of deferred payments as contemplated by the Act, and it would also seem to be to the advantage of Co-operative Trading Societies as it would in effect enable them to provide credit facilities for their customers on a larger scale than they would otherwise be able to offer.

Loans to Co-operative Enterprises.—A sum of £200,000 has been provided by Parliament in order to enable the Ministry of Agriculture to make loans to develop forms of co-operation directed to the preparation and marketing of agricultural produce, such as bacon factories and milk depôts, and a committee of business men and persons interested in co-operation has been appointed to advise the Ministry in regard to the making of these loans. A number of applications are under consideration. The amount of the loan to any one Society under this scheme is limited to £10,000.†

Assistance under the Trade Facilities Acts.—The needs of large undertakings which require more money than can be provided under the above scheme are met by the Trade Facilities Acts.

* No. 311.

† The conditions under which loans will be made are printed at p. 480.

Under the terms of the Trade Facilities Acts the Treasury may guarantee the interest and repayment of loans raised in connection with the carrying out of any capital undertaking, or for the purchase of articles manufactured or produced in the United Kingdom which are required for the purposes of any such undertaking, if they are satisfied that the application of the loan in the manner proposed is calculated to promote employment in the United Kingdom. The guarantees cannot be used for the provision of working capital, nor for the purpose of extinguishing existing liabilities.

Agricultural undertakings which might be eligible for consideration are sugar-beet factories, dairy factories or milk depôts, large bacon factories, live-stock auction marts, fruit markets or other large-scale undertakings dealing with agricultural produce.

Note.—Further particulars of any of the schemes referred to above may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

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Fourth International Seed-Testing Congress.

THE Fourth International Seed-Testing Congress was held at Cambridge from 7th to 12th July, and included visits to Rothamsted Experimental Station and the British Empire Exhibition. An excursion programme was also arranged from 14th to 16th July to enable the delegates to visit the warehouse and seed-cleaning plant of the Eastern Counties Farmers' Co-operative Association, Ltd., the seed establishment of Messrs. Sutton and Sons, Reading, and the Royal Botanic Gardens, Kew.

The Congress was attended by official delegates from the following countries: Argentina, Belgium, Canada, Czecho-Slovakia, Denmark, Egypt, England and Wales, Finland, France, Germany, Greece, Holland, Hungary, Irish Free State, North Ireland, Lithuania, Norway, Poland, Rumania, Russia, Scotland, Sweden, Switzerland and the Ukraine. The International Institute of Agriculture at Rome was also represented, and officials of the United States Department of Agriculture attended.

With one exception the meetings of the Congress were held at the National Institute of Agricultural Botany, Cambridge. The Congress was opened on 7th July by Sir Lawrence Weaver, who welcomed the delegates. Mr. Alfred Eastham, the Director of the official Seed Testing Station for England and Wales,

Cambridge, then read a paper on the work of the Station. The delegates were subsequently entertained at lunch by the Council of the Institute. The afternoon session was devoted to a report by Director K. Dorph-Petersen, of Copenhagen, on the work of the European Seed Testing Association.

On 8th July, Director Dr. A. Volkart, Zurich, put forward a proposal regarding regulations for the European Seed Testing Association; Mr. T. Anderson, Edinburgh, read a paper on Uniformity in Seed Testing Reports; Dr. Y. Buchholz, Christiania, a paper on the Determination of the Water Content of Seed; Professor L. Bussard, Paris, a paper entitled "Should not the percentages by weight of weed seeds, and the names of the species which occur most frequently, be quoted in each purity determination; and which are the species which should always be counted as weeds?"; and Director Dr. A. v. Degen, Budapest, a report on the work of the Dodder Committee appointed at the Copenhagen Congress, and a paper on the Longevity of Seeds.

Papers read on 9th July were by Professor Dr. A. Voigt, Hamburg, on Germination Tests, especially of Clover and Grass Seeds; by Director Dr. W. Franck, Wageningen, on Germination Investigations by Low Temperature; by Director Dr. A. Volkart, Zurich, on the Determination of Origin established by the European Seed Testing Association; and by Mr. Edgar Brown, Washington, and Dr. G. Pammer, Vienna, on Valuation of Hard Seeds and Determination of Broken Seedlings. The afternoon session, held at the School of Agriculture, at which the papers by Dr. Volkart and Messrs. Brown and Pammer were read, was attended by the delegates to the International Seed Trade Conference, which was being held in London concurrently with the Seed Testing Congress.

The morning session of 10th July was devoted to papers by Director K. Dorph-Petersen, Copenhagen, on Investigation of seeds which are not fully matured, and determination of the germinating power in the soil of such seeds; and Director Dr. F. Chmelar, Brunn, and Dr. Gentner, Munich, on Laboratory and field investigations on purity of strain and the investigation of diseases which are transmitted by the seed. The delegates were entertained at lunch by the Master of Magdalene College.

At the afternoon session it was unanimously agreed to extend the scope of the European Seed Testing Association, which was formed at the third International Seed Testing Congress held at Copenhagen in 1921, so as to make it fully international. The

constitution of the new International Association was approved. The object of the Association is the advancement of all questions connected with the testing and judgment of seeds. An Executive Committee and several special Committees to deal with various problems connected with seed testing were formed.

An invitation from the International Institute of Agriculture to hold the next International Congress in Rome was unanimously and cordially accepted, and it was agreed that this should be held during the first half of May, 1927. It is proposed that the Association shall work in co-operation with the International Institute of Agriculture, and arrangements have been made for papers of interest to the Association to be published in the Bulletins of the Institute.

The next day, 11th July, was fully occupied by a visit to Rothamsted, and at 8 p.m. the delegates were entertained at dinner in the Hall of Trinity College, Cambridge, by the British Government, the Rt. Hon. Noel Buxton, Minister of Agriculture, presiding. In extending a hearty welcome to the delegates and other guests, on behalf of the Government, Mr. Buxton said the Government fully recognised the importance of seed testing, and it was felt to be a privilege to be able to hold the Congress at Cambridge. In agriculture rather more than a well-prepared fertile soil was needed. Seed testing was essential to the improvement of seed and to the solution of present-day problems. He paid a tribute to the work of Professor Biffen in producing new wheats, and urged that more of these wheats should be grown in this country. If they were, there would be a great addition to our national resources, and there would be a great economy in transport, as foreign wheat would not need to be transported to the same extent to mix with our home-grown wheat. He hoped and felt sure there would be good results from the meetings of the Congress.

Professor Dr. W. L. Johannsen, Copenhagen, and Dr. A. Volkart, Zurich, replied on behalf of the delegates. The toast to the Chairman was proposed by Dr. Erik Insulander and seconded by Sir Lawrence Weaver. The singing of mediæval pastorals by the Choir of Trinity College, and the singing of Grace at the close of the dinner, greatly added to the interest of the delegates and other guests.

It should be added that both the Congress and the Ministry are greatly indebted to the authorities of Trinity College, Emmanuel College and Selwyn College for their courtesy in lodging and entertaining within their historic precincts so many of the delegates and others attending the Congress.

Studies Concerning the Handling of Milk.

THE annual expenditure by the State on agricultural research now reaches very considerable dimensions, partly as a result of the provision by the Corn Production Acts (Repeal) Act of the fund of £850,000 for the development of agricultural research and education. A proportion of the annual expenditure (amounting approximately to £130,000) takes the form of annual grants in aid of fundamental and continuing research work carried out at Agricultural Research Institutes, each of which deals with a special subject (soils, plant diseases, fruit growing, dairying, and so on). There are still a few gaps in the scheme of agricultural research, but these are being filled, and the nation may justly claim that it has created an organisation which covers every side of agriculture and has laid the foundations for that complete scientific investigation upon which any great and lasting improvement of agricultural practice must ultimately be based.

A policy which has for its object the increase of facilities for research would be incomplete without arrangements for ensuring that the results of research are made available for farmers. For this purpose a service of specialist advisory officers (entomologists, mycologists, chemists, economists and veterinarians) attached to University Departments of Agriculture and Agricultural Colleges has been established, the country being divided into fourteen provinces for the purpose; and County Councils have appointed agricultural organisers and county agricultural staffs. It is the duty of all these officers to familiarise themselves with the results of research, apply them to local conditions, and bring them home to the best of their ability to farmers in their areas.

Lectures given by University, College, and County lecturers on agricultural subjects to students at Agricultural Colleges, Farm Institutes and audiences of farmers and farm workers aid in the dissemination of new knowledge. Quite recently the Ministry of Agriculture has set on foot, in co-operation with the National Farmers' Union, a scheme by which addresses at meetings of branches of the Farmers' Union are given by the men who are engaged in research work at the different Institutes.

The spoken word has a magic which the book cannot possess, but all things are not meet to be spoken, and the printed word, moreover, can reach those who have no opportunity of hearing lectures. The Ministry has published a large series of leaflets, dealing with every branch of agricultural practice, which are revised frequently to embody the latest results of research; and

every month this *Journal* brings to a considerable agricultural public one or more articles by research workers detailing their methods and results.

Besides the farming community, however, it is necessary also that the wider public should be made aware of the progress of agricultural research; and as much with the object of informing them as the farmer, the Ministry in 1921 directed Mr. V. E. Wilkins to compile a readily intelligible, summary account of practically the whole of the work on which agricultural researchers were then engaged. The resulting book, "Agricultural Research and the Farmer," received a cordial welcome and a ready sale, more than sufficient to encourage the Ministry to proceed with the publication of a series of monographs taking in turn subjects upon which the research worker has something new and valuable to say to the farmer and saying it in greater detail than was possible in Mr. Wilkins' book.

The first monograph of the series,* has been compiled by Dr. Stenhouse Williams and the staff of the National Institute for Research in Dairying. This Institute dates back to 1911, for it was on 30th September in that year that the then Board of Agriculture received a memorandum urging the suitability of Reading as a centre for dairying research, and in reply indicated its willingness to make a two-thirds contribution up to £2,500 per annum towards the cost of such an Institute. The first payment authorised by the Ministry was one of £7 on milk churns, milk, sterilising, etc., in connection with an investigation into the effect of ventilated and unventilated churns on the keeping properties of milk in transit. In 1912-13 the Ministry's annual grant was £1,510, an amount which has gradually increased to about £8,000 a year. The Institute, whose work touches vital questions of public health, is supported also by the Ministry of Health, and the Medical Research Council, as well as by the Royal Agricultural Society of England and the dairy industry.

Large sums of money have been raised by the Institute for capital purposes and the Treasury has, since the war, sanctioned capital grants amounting to £32,000 on the condition that equal sums are raised from other sources. With this assistance, and also largely through the munificence of Viscount Elveden, the Institute has been able to provide itself with new buildings and a farm of its own, where its work will continue and develop

* "Studies concerning the Handling of Milk," Misc. Pubn. No. 41, to be obtained at the Ministry's Office, 10, Whitehall Place, London, S.W.1. Price 1s., post free.

under the best conditions. Further financial assistance from other than Government sources is, however, still a crying need of the Institute.

The subject chosen for this first monograph is of particular interest at the present time in the light of the Milk and Dairies (Amendment) Act, 1922, and the attention which is now given to the production of clean milk. The book has been written in as simple language as possible, and the use of scientific terms has been reduced to a minimum in order that it may be readily intelligible to all classes of readers. It should appeal to a wide public—dairy farmers, milk distributors and sellers, medical men—and, it is to be hoped, to some at least of the milk-consuming public, who are not professionally interested in it. Milk is not consumed either in sufficient quantity or in such a condition of cleanliness as to promote, as it might promote, the health and well-being of the people, who cannot afford to be ignorant of how it is produced and distributed, and of how those things might be better done with advantage to producer and consumer alike.

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Prevention of Introduction of Foot-and-Mouth Disease.

THE Minister has made an Order, the Foreign Animals Order of 1924 (No. 2), which came into operation on 15th July, requiring the Master of any vessel which has within 60 days before entry into port carried animals from a prohibited country to any other country, to make a declaration to that effect to the Ministry immediately upon entry into port. The Order further prohibits the discharge of any cargo unless, and until, the landing has been authorised by the Ministry subject, if the circumstances require it, to special disinfection of the vessel or cargo. The Order has been widely promulgated to all concerned. Its object is to prevent the risk of the introduction of foot-and-mouth disease through cargoes of feeding stuffs which may have been contaminated by contact with infected animals or through excreta whilst on board.

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Sheep Scab Regulations.

THE representations made by the deputation to the Parliamentary Secretary of the Ministry on 14th May from the Local Authorities of Scotland and the National Farmers' Union of Scotland, to protest against the proposed regulations forbidding the movement of undipped sheep from Scottish counties into English counties has been carefully considered by the Ministry,

and a reply was sent on 24th June to the effect that, in view of the present position of scab, the Ministry could not see its way to deprive those Local Authorities who are anxious either to eradicate disease from their areas, or to maintain their existing immunity from scab, of their existing powers to make regulations for the protection of their district. A promise was made, however, that if, as a result of the measures taken under the Sheep Scab Order of 1923 to reduce the prevalence of the disease, a more satisfactory position is achieved, the Ministry would consider amending the powers of Local Authorities to make such regulations, in the direction of securing that such regulations should not be applicable to sheep moved from clean counties where those counties took adequate precautions against fresh invasions.

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Cattle Judging by Young Farmers.

IN the July issue of this *Journal* Mr. Alexander Gregg, Lecturer in Agriculture on the staff of the Cornish County Council, put forward a plea for an extension of judging competitions to young farmers at our county shows, and instanced the valuable results obtained and the public interest aroused by the judging events held yearly in connection with the shows at Wadebridge, Truro and Helston. These events include the judging of a fat steer, a long-woolled sheep, six roots, samples of cereals, the identification and naming of grasses, clovers and weed seeds, and the naming and valuing of foods and manures.

Such competitions are a considerable feature of American shows, and it is evident that they would have great educational value for the young agriculturist in this country. A beginning has been made over here in cattle-judging contests. An event of this nature, which has recently taken place, is the third international cattle-judging competition, promoted by the International Federation of Young Farmers' Clubs, which took place in Mr. M. D. Bannister's grounds at Haywards Heath, Sussex, on 11th July last. A selected English team of three girls (all members of calf clubs supported by the United Dairies Limited) competed with a representative American team of three boys for possession of a gold cup awarded by the *Daily Mail*, and a useful comparison could therefore be made between English and American methods of training in this direction.

The company which Mr. Bannister entertained at luncheon before the event was representative of many interests. In addition to members of the Embassy staff the American visitors

included Senator McCormack, Mr. Steele (London Correspondent of the *Chicago Tribune*), Professor Rhode and Mr. Wise (county agent for agricultural extension work in Illinois). Mr. P. B. Tustin (of the International Federation of Young Farmers' Clubs), Captain Skelton, Mr. Holt Thomas and representatives of the Ministry of Agriculture were among the British guests. The speeches opened up inspiring vistas of the opportunities of service which lie before the movement. Senator McCormack, responding to Mr. Bannister's hearty welcome of the American guests, stressed the great educational influence of the clubs in the United States and, speaking both as a practical agriculturist and as a politician, emphasised the contribution of agricultural education to the needs of the industry. Mr. Tustin alluded to the many possibilities of development in this country, and Mr. P. G. Dallinger referred to the sympathy with which the Ministry of Agriculture had always viewed the movement and to the probability of more active support in the future.

The brilliant weather and the interest which had been aroused among the agriculturists and the young people of the neighbourhood combined to make the contest a very pleasant function. The delightful rural setting, the well-turned out cattle and the workmanlike kit of the girl competitors made a pretty scene which attracted many photographers. Professor Rhode and Captain Skelton acted as judges.

The test consisted of the judging of three classes of dairy cattle (Shorthorns, Jerseys, and Friesians). In each case the competitors were given 15 minutes to survey the stock, and then place them in order of merit, reporting to the judges their reasons for the arrangement they had made. The businesslike manner in which the contestants conducted the investigation and recorded their opinions, was the subject of favourable comment from the audience. In announcing the result the judges stated that the American teams were the victors, with a score of 1,590, but that the contest had been very close as the English team had secured 1,484 marks. The English side had done well in the judging of the Shorthorns, but had rather lost ground in the other two classes. The individual totals were given as under :— D. Williams (U.S.A.) 545, J. Gaulrapp (U.S.A.) 530, Winifred Emery (England) 518, E. Folkers (U.S.A.) 505, Mary Banbury (England) 498, Joan Moore (England) 468.

The gold cup was presented to Donald Williams, leader of the American team, by Mrs. Bannister.

The American team, sons of working farmers in the State of Illinois, have visited, by the generosity of the *Daily Mail*,

representative farms and shows during their stay over here, and will carry back with them considerable knowledge of agricultural conditions and agricultural problems in this country. The superior efficiency of the American team is no doubt partly attributable to the greater attention devoted, on the other side of the Atlantic, to the agricultural education of the young. It is to be hoped that the organisation of Young Farmers' Clubs in this country may now be taken in hand on lines more comparable to the system in vogue in the United States. There is splendid material at hand in the young boy and girl farmers of these islands: there is general agreement that the main hope of the countryside lies in the training of the future agriculturist in an intelligent appreciation of country life and of the value of agricultural education. It remains to make the maximum use of the Young Farmers' Club movement, which has already been brought to an interesting stage in this country, and which has attained its fullest development in the United States of America.

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Drainage Works for the Relief of Unemployment, 1924-25.

THE Government have now decided that, subject to the necessary funds being voted by Parliament, drainage works for the relief of unemployment shall be continued in the coming autumn and winter. Although no works may be started before 1st October next, there is no reason why applications for grants should not be submitted forthwith, as arrangements have been made for the preparation throughout the summer, by County Agricultural Committees and Drainage Authorities, of schemes for putting into operation next autumn.

In previous seasons the work has been handicapped owing to the conditions not being published until the middle of September or even later. This season the Ministry issued the conditions to all concerned on 25th June, a preliminary notice having been issued some weeks earlier, and it is hoped that the longer time available for the preparation of schemes will be a factor in increasing both their value and their number. Full particulars of the conditions governing the Ministry's grants—which do not differ materially from those applicable in the case of schemes carried out last season—can be obtained from Clerks of County Councils or from Drainage Authorities, but it should be noted that the grants will be available only for combined schemes for the improvement of groups of holdings or properties, and not for field drainage work.

The Ministry has received repeated and striking testimony as to the high value of these relief schemes. It is hoped that all concerned will co-operate cordially in making this season's programme an even greater success than those of the three previous seasons, and at the same time improving the drainage of large tracts of agricultural land in all parts of the country.

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The Agricultural Index Number.

THE index number of prices of agricultural produce has risen a further 2 points, June prices being on the average 58 per cent. above those in the corresponding month of 1911 to 1913. There has thus been a rise of 5 points in two months, but prices remain relatively rather lower than in January and February. As compared with last year, however, the figures are now showing a distinct divergence, and there is a difference of no less than 7 points between the June figures in the two years.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

The index numbers of all kinds of cereals showed an advance between May and June, although the rise in the case of barley is due to a fall in the basic years 1911 to 1913, barley actually selling on the average at 2d. per cwt. less in June than in May. The June price of wheat is slightly higher than a year ago, and barley shows a decided improvement, but oats are relatively cheaper than last year. All the cereals, however, are now very scarce, and the higher prices are in respect of comparatively small quantities.

As in the case of cereals, potatoes have been in very limited supply throughout June, and, with increasing supplies of imported new potatoes available, demand has been dull with a considerable fall in prices. Average prices in June were 27s. 6d. per ton below those of May, and the index number has declined 45 points on the month. At the same time the average

of prices in June is nearly four times that of June last year, when potatoes were selling wholesale at about 30 per cent. below pre-war prices.

Fat cattle and fat sheep both showed an advance on the month, the former of 4 points and the latter of 6; in each case, however, the rise is accentuated by the fact that prices declined between May and June in pre-war years. Fat pigs also fell between May and June in the basic years, but there has been a relatively greater fall this year and a slight decline in the index number. Both cattle and sheep are a shade dearer than a year ago, but pigs are much cheaper.

All classes of store stock are firm in value, with the exception of store pigs, which have fallen in sympathy with fat pigs and now sell at about 32 per cent. above pre-war as compared with 130 per cent. above pre-war a year ago, when additional firmness was imparted to the market by the heavy stocks of potatoes left over from the previous season's crop.

Eggs and poultry have risen 3 and 6 points respectively on the month, but in the case of poultry the rise is due not to an actual increase in price but to the fact that the seasonal fall this year is relatively smaller than usually occurred before the war.

Milk shows no change either actually or relatively to pre-war, but cheese and butter, although both a shade cheaper in June than in May, have advanced a few points owing to the greater fall normally occurring at this season in pre-war years.

Index numbers of different commodities during recent months and in May, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. June.	1924. Feb.	Mar.	Apr.	May.	June.
Wheat ...	38	44	46	38	38	42
Barley ...	17	43	45	48	46	48
Oats	41	41	39	35	30	32
Fat cattle ...	52	54	52	49	51	55
Fat sheep ...	83	75	64	75	87	93
Fat pigs ...	69	34	33	35	32	31
Dairy cows ...	50	48	64	63	58	59
Store cattle ...	31	39	41	38	42	47
Store sheep ...	114	89	85	84	96	121
Store pigs ...	130	50	45	42	36	32
Eggs... ...	40	75	68	48	40	43
Poultry ...	87	52	59	70	87	93
Milk	53	87	71	58	50	50
Butter ...	33	71	63	51	40	43
Cheese ...	44	72	71	71	77	83
Potatoes ...	—31*	170	173	154	219	174
Hay	42	—1*	1	0	4	3

* Decrease.

THE ROYAL SHOW.

THE 83rd Annual Show of the Royal Agricultural Society of England was held at Leicester from 2nd to 6th July. The weather was exceptionally fine, and the number of foreign visitors considerable.

As is usual at this show interest centred in the live stock classes, and this year the interest was perhaps heightened on account of the long period during which our farmers have suffered so severely from foot-and-mouth disease and the attendant restrictions.

As was anticipated the live stock section was seriously depleted in numbers owing to the fear of foot-and-mouth disease, and the policy of some counties of not allowing exhibits to return after the show. In the cattle classes alone no fewer than 500 animals out of an entry of 1,300 were absent, but although reduced in numbers of entries these classes provided a very fine show of cattle, and generally speaking the high standard of excellence expected at this show was maintained.

Cattle.—Shorthorns, the most widely distributed and popular breed in Great Britain, were a magnificent display, and were the centre of much interest during the judging. So long as breeders can produce the type of animal represented in the prize-winning list there is little fear of that popularity declining. In the section of the breed confined to dairy animals, however, there was some evidence amongst unsuccessful exhibits that breeding for milk alone is bound eventually to entail loss of type and constitution.

Numerically, the Lincoln Red Shorthorn classes were not as strong as one might have hoped to see at a show held in Leicestershire, a county which is mainly grazing and dairy lands, and in which this good, dual-purpose breed is rapidly spreading and becoming deservedly popular. Quantity was, however, more than balanced by the quality of the exhibits. Hereford classes were well filled and were conspicuous for uniform excellence, and another famous beef breed, the Aberdeen-Angus, although short in numbers yielded keen competition and made a most creditable show. Of the dairy breeds British Friesians were the most numerously represented, and the classes were very uniform in merit, as also were those confined to Jersey cattle.

Horses.—The entry of horses was one of the largest in recent years, and there were few absentees. At a show in the Midlands

one expects to find the Shire breed well represented, and Leicester proved no exception to this rule. Unquestionably the Shire classes reached an exceptionally high standard, and gave the judges a troublesome and very hard day's work. The result was an impressive display of grand horses in the prize-winning ranks. To anyone who has not attended the Shire shows for some years the improvement in this breed must be obvious. The leggy type, with no "middle-piece," which was formerly too much in evidence, has to a great extent disappeared, and the compact, deep-bodied and massive horse of to-day is no doubt responsible for the increasing interest shown in this breed by visitors from abroad. The Shire geldings also were good, and the judging of these powerful cart horses was keenly followed.

The number of Clydesdales shown was, of course, small as compared with shows held in the northern counties, but the prize list included some fine specimens of the breed. The clean-legged cart-horse breeds attracted much attention and are, no doubt, growing in popularity. Both Suffolk and Percheron have proved their worth as good workers and hardy constitutional horses, and have converted many who thought that an abundance of hair on the legs was an absolute necessity to a cart-horse. The beautifully placed shoulder of the Percheron also catches the eye not only of the heavy-horse breeder but also of the man on the look out for a mare with substance to mate with the Thoroughbred.

Pigs.—In common with the cattle section the pig classes suffered from the large number of absentees, though Large Blacks and Middle Whites were well represented in numbers. The improvement shown in both the Large White and Middle White breeds in recent years is remarkable. The former is now on a much shorter leg and is deeper sided, while the Middle White is a much more lengthy pig than formerly, and the coarseness of shoulder which disfigured this breed is being eliminated. The latter defect, however, is still rather too obvious. There can be no doubt that both these breeds are vastly improved from the bacon-curer's and butcher's point of view as compared with what was considered ideal a decade ago.

Machinery.—The machinery exhibits and stands hold a very good second place in the appeal they make to visitors to the Royal Show. At the recent show the machinery exhibit not only reflected the financial position of the farmer but the latest work in agricultural engineering. There were, for example, many fewer tractors than a few years ago. The American invasion is

now practically confined to a few standard lines, such as the Fordson, the International and the Case. British manufacturers were well represented, although the only striking new design was a rein-driven tractor shown by Messrs. Fowler of Leeds. It was not very clear that this design has any substantial advantages over the standard designs, and it would be interesting to see the machine tried out in the field. At the present level of prices, however, the high cost of this machine is likely to prejudice its sale.

Although tractors were fewer, thrashing machines of the smaller type for use with tractors were much in evidence, while the increased attention which has recently been given to mole draining was reflected in the number of mole ploughs for direct haulage by tractors. Here we have evidence of the general usefulness of tractors to those farmers who retain them, and some indication that the present slump is but temporary.

Cable engines were represented not only by the well-known steam types, but also by an internal combustion engine set of new design by Messrs. Fowler, as well as sets by Messrs. Maclaren and Messrs. Borsig. These sets are, of course, only for the landowner or large farmer.

At the other end of the scale we may notice small petrol engines for barn machinery, water pumping and lighting, the demand for which is clearly increasing. Many firms are manufacturing for this market, and the prices are now within the reach of practically every farmer; the advantages of small engines is such that, even in a period of financial stringency, many purchasers can be found.

The farmer's reduced purchasing power is doubtless responsible for the comparatively small number of new devices. A few items only call for special notice. The design of the potato lifters on exhibition showed marked improvement, particularly with a view to reducing the labour of gathering the crop when lifted. A number of potato planters were also being shown.

Messrs. Ransome's have constructed a "grass rejuvenator," intended to replace the chain harrow, the object being to clear out any matted material, and to give a form of surface tillage to a depth of about 2½ inches. The implement, it is stated, can easily be pulled by three horses, and it could doubtless be as effectively operated by a tractor.

Agricultural Education and Research.—In the Agricultural Education Exhibit, to which a number of representative institutions contributed, the National Institute of Agricultural Botany

showed interesting models and diagrams of the "alternate drill strip" method of testing the yield of cereals in field trials,* and models and tables of the "chequer board" method for testing yield and maturity of potatoes. The use of the leaf index as recently worked out by Dr. R. N. Salaman for testing varieties of potatoes was included in the exhibit. The section illustrating the work of the Official Seed Testing Station was exceedingly modest, and hardly did justice to the importance of the subject.

The exhibit of the Rothamsted Experimental Station was full of interest, among other exhibits being one showing the effects of boron on the culture of leguminous plants in water, and a selection of the Rothamsted publications.

There was a joint exhibit by the Animal Breeding Research Department of the University of Edinburgh, and the Department of Agriculture, University College of North Wales, of sheep breeding, with special reference to wool improvement. The schemes involving hybridisation included one for the improvement of British wools by crossing with Peruvian merinos; those without hybridisation included a scheme for the improvement of the wool of Welsh Mountain sheep with special reference to the elimination of "kemp." One interesting feature of the exhibit had reference to a curious limb deformity causing the death of new born lambs, which was illustrated by photographs and charts.

The Midland Agricultural and Dairy College had a representative exhibit of the work done at the college. The exhibit was divided into four sections:—(1) Agriculture in general, which included a model of the college and station farm; (2) Dairying, including typical specimens of the leading varieties of hard pressed cheese, soft pressed cheese, cream cheese, Stilton and Wensleydale; (3) Chemistry, including samples of mechanical and chemical analyses of typical Leicester soils; and (4) The Advisory Department, dealing with pests and methods of prevention.

The exhibit of the National Institute for Research in Dairying dealt with dairy husbandry, dairy bacteriology and dairy chemistry, and aroused a good deal of interest.

The Adult Agricultural Education exhibit of the Leicester County Council was one on which a great deal of time and thought had been expended, and both in range and quality, as well as in the method of display, it reflected credit on all con-

* See "Trials of New Varieties of Cereals," by E. S. Beaven, this *Journal*, July and August, 1922.

cerned. In an exhibit of this kind, part of which was in the open and part in a tent, it adds greatly to the pleasure and instruction of the visitor when the grouping is good, the description clear, and the space allotted adequate, and we have seldom seen an education exhibit in which all these essentials were more happily blended. The exhibit consisted partly of small plots in the open containing varieties of cereals, grasses and clovers, and forage crops suitable for the county. All the plots were clearly labelled, well cultivated, and in almost all the crop had done exceedingly well. There was a demonstration allotment illustrating the most useful method of cropping for the small allotment in Leicestershire. The condition of the crops throughout was exceedingly good and evoked a great deal of favourable comment, and the model—a well-deserved title in this instance—attracted a great deal of attention.

A small poultry farm was exhibited below the allotment in which the following breeds were represented: White Leghorn, Black Leghorn, Rhode Island Red, Barnevelder and White Indian Runner ducks. The birds were lent by breeders in the county, and were suitably housed and provided with wired-in grass runs.

In the tent were exhibits illustrating practically all the branches of work undertaken by the agricultural staff, and careful and successful staging added very greatly to the educational value of each section of the exhibit. It is not possible to refer to them in detail, but the improvement of grassland was illustrated as usual by specimen turves; diseases of plants by preserved and fresh specimens; and there was an unusually interesting exhibit illustrating poultry diseases.

An exhibit such as that of the Leicestershire County Council demonstrates very clearly what a useful opportunity may be afforded by the agricultural show to make known the work which is being done in the interests of agriculturists in a county, and although the preparation of such an exhibit as this must have made considerable calls on the time of the staff at a very busy season of the year the results afforded ample justification for it.

Roots and Seeds.—The plant breeding exhibits of the leading seedsmen proved how widely the farmer has accepted the results obtained by the research of agricultural scientists and how extensively the trade has developed this branch of agriculture.

The modern farmer realises that pedigree strains of seeds are as important as pedigree breeds of live stock, and is taking increased interest in the quality and productiveness of all kinds

of seeds. With the present high production costs high yields are essential. By means of cross-fertilisation and pure line selection new and improved varieties are produced each year: improvement is seen not only on the lines of increased yield but in milling qualities, feeding value, non-liability to lodge, and adaptability to certain soils and climates.

In the past most attention has been directed to the improvement of cereals, both on account of the large acreage grown and the relative high value of the crop. A high standard has now been reached, and the majority of farmers are already familiar with the existing improved varieties of cereals. For the coming season, however, the seed of the following new wheats will be available, in addition to several improved types of existing varieties of other cereals :—

(1) Yeoman II, similar to Yeoman in general characters and milling properties, but promising a higher yield.

(2) A selected sort of Wilhelmina, a new white wheat, specially adapted to heavy land in high condition, such as highly manured hop yards or gardens of Worcester and Hereford. It is claimed that whilst yielding as well as Wilhelmina, it has the advantage of being shorter in the straw, with the ear shorter and more closely packed, while it is not liable to lodge even under conditions most favourable to lodging.

(3) Svalof Iron Wheat No. 3, similar to Iron No. 2 but producing a heavier yield.

Perhaps the most marked advance has been made in the improvement of the varieties of roots. An exhibit of particular interest illustrated the development of the mangold, showing roots representing the old types of mangold and the improved strains of Red Intermediate, Yellow Globe, Golden Tankard and Sugar Mangold, indicating the great improvement in external characters. Still further improvement achieved in recent years, not obvious to the eye but of greater importance, was illustrated by figures showing the higher percentage of dry matter and sugar contained in mangolds obtained by selecting stocks. Seed can now be purchased on the basis of the feeding value per acre of the crop.

Since the advent of wild white clover increased attention has been given to the composition of seeds mixtures and the detailed study of grasses and clovers. Experiment has confirmed a common observation, namely, that indigenous plants are often found superior to ordinary commercial strains in certain valuable characteristics. Exhibits were staged showing carefully selected

strains of English perennial rye grass, French Italian rye grass, and Timothy characterised by an upright habit of growth and leaf development which is absent in the typical commercial seed from Ireland. These indigenous strains produce a more nutritive crop and encourage the growth of clover.

Plants giving the most foliage produce the least seed, and the tendency to produce commercially high seed-yielding varieties has resulted in the promotion of stem and flower production to the detriment of leaf production.

British Wool.—Having regard to the importance of wool in the industry of this country, the question of the utilisation of home-grown wool is a most attractive one. Especially is this so when so much of the best and most highly-priced wool used in our factories is obtained from overseas, and it has become an important economic problem to replace some of this by British wool.

The number of breeds of sheep in this country is so large, and the wools from their fleeces are so various, that for the purpose of experiments designed to produce better cross-bred wools for the English market, we have an unrivalled quantity of material. There are two problems: (1) the better preparation, grading, and selling of the various herd-wools as they exist to-day, and (2) the improvement of British wools by crossing with Merino and other fine-woolled varieties. Both aspects, but mainly the first, were dealt with by Professor Barker in an exhibit covering "The Nature of British Pedigree Wools," put up on behalf of the Royal Agricultural Society and the Leeds University. The nature of the wool was "as revealed by fibre examination," and by experiments with typical wool and worsted yarns and fabrics produced from each breed, including experiments in shrinkage and dyeing.

The exhibit was well staged in a large and well-lit pavilion. On the walls of one side and one end were typical woolled skins, representative of 27 native breeds, on each of which the qualities of wool on the fleece were mapped out by tape outlines enclosing figures indicating their excellence. Below the skins were photographs of typical specimens of the breeds, and several samples were shown of woollens and worsteds produced from the wool of each breed. Imposing and exhaustive as this section of the exhibit was, it formed only a part of the whole. A great deal of attention had been given to the fibre measurement of each breed, and the results were illustrated by diagrams and by the listing of the breeds according

to the average fineness of the wool produced. There were also samples of cloth showing the variation in the amount of shrinkage in materials produced from different varieties of native wool, and a complete range of samples illustrating the effect of dyeing.

On the question of improvement of breeds, the exhibit included photographs of breeds of sheep in relation to the crossing of wool strains, and illustrative of other interesting and historical matter. There can be little doubt that the exhibit was of the greatest interest and value to the sheep farmer.

Horticulture.—Regular visitors to the Royal Show who are interested in flowers must have noted with pleasure the growth of the horticultural section in recent years. This year the section was particularly attractive and on a larger scale than hitherto. It was organised by the Horticultural Committee, of which Sir Gilbert Greenall, Bart., C.V.O., was Chairman, Sir Arthur Hazlerigg, Bart., Director of the Horticultural Exhibit, and Mr. Peter Blair, Official Manager. The exhibit, stages in two large marquees, consisted of (*a*) a competitive group, and (*b*) a non-competitive group.

There were in all ten competitive classes in which substantial prizes were offered for collections of the more popular cut flowers, such as delphiniums, carnations, sweet peas and roses, pots of tuberous begonias and orchids. The individual exhibits, which were of an exceptionally high standard were put up by the well-known specialist nursery firms. Amongst the non-competitive exhibits there was an excellent terraced garden suitable for a country mansion; and brilliant displays of sweet peas, roses, carnations, canterbury bells, rhododendrons, and of almost every garden flower. There were pots of growing fruit trees laden with cherries, plums, pears and apples; baskets of large and delicious strawberries of many varieties; and most excellent specimens of garden vegetables. This section attracted many visitors who were busy noting down names of choice roses, favourite sweet peas, and of other flowers, fruit, and vegetables for home culture; in that sense the Section must have been an asset to those who are unable to visit the large horticultural shows held in London, York and Shrewsbury.

Exhibits of horticultural interest could also be found in many parts of the exhibition. In the Agricultral Education tent the National Institute of Agricultural Botany had an important potato exhibit where one could see bottled and pre-

served specimens of some of the newer immune varieties, learn from the leaf measurements how to distinguish varieties, and study the correlation between flower characters and colours of tubers. From the Rothamsted Experimental Station exhibit one learnt of the important influence of small quantities of boron on the flowering and fruiting of peas, beans and scarlet runners. One part of boric acid in two-and-a-half million parts of water produced superior plants to those grown without boron. On the Midland Agricultural College stand one was able to see potato plants in pots manured with different potassic fertilisers, and from a study of charts to learn that the College had found the most economical dressing for potatoes on the college farm to be 12 tons of dung together with 10 cwt. of a mixture in the proportion of 3 parts superphosphate, 1 part sulphate of ammonia, and 1 part sulphate of potash.

In the Implement Department exhibits of spraying machines, potato diggers, potato sizing machines, rotary diggers, fruit plantation cultivators and lawn motors were numerous and comprehensive. During the past few years the lawn motor has undergone many changes, and power mowers of large and small sizes to suit varying needs are available.

The time at which the show is held makes it impossible for the Society to offer prizes for fruit. There was held, however, a most excellent competition of orchards and fruit plantations confined to an area comprising the counties of Hereford, Worcester, Gloucester and Warwick, and no fewer than 75 orchards were entered for inspection by the two judges, Mr. Cuthbert-Smith (Kent) and Mr. A. W. Turner (Somerset). These competitions encourage growers to interest themselves in orchard management and the orchard foreman to take pride in his craft, and though they bring difficulties in organising and there is nothing to present on the show grounds, they are worthy of further development.

The Working Dairy.—The working dairy was conducted on lines similar to those which have been adopted for several years past. No practical competition between trained workers in dairying was provided. Instead, the whole of the working dairy was devoted to demonstrations, explained from time to time by short lectures, and to carrying out various tests, *e.g.*, testing the weights of butter obtainable from equal quantities of milk from the various dairy breeds exhibited. The Royal Agricultural Show is the occasion which probably provides the best opportunity for comparing the behaviour of breeds in certain

respects when kept under the same conditions, and for this reason it is commendable that advantage should be taken of the opportunity. On the other hand, there is some justification for the criticism, that the circumstances under which the tests are conducted do not lend themselves to obtaining reliable information. However true this may be normally, they do reflect the behaviour of different breeds when under agricultural show yard conditions.

There are two schools of thought regarding the wisdom of the Royal Agricultural Society in excluding from the programme of the working dairy competitions between skilled technical workers in such arts as butter-making. Almost every other agricultural show provides these competitions and they invariably prove a popular feature. It is true, however, that unless they are carefully organised such competitions may become the hunting-ground of competitors who make it a business to proceed from show to show. Where it is thought necessary, however, to prevent action of this kind it is a comparatively simple matter to arrange the conditions so that such persons are excluded. There is much to be said in favour of holding competitions in technique, particularly if they are so designed as to encourage specially those workers who have undergone recent training.

Clean Milk Production Demonstration.—This is the second year in which the Royal Agricultural Society has provided separate and special accommodation for the provision of practical demonstrations of the production of clean milk. The accommodation at Leicester was in every way satisfactory. These demonstrations were very effectively provided by the staff of the National Institute for Research in Dairying, and proved to be a source of great interest to dairy farmers and stockmen as well as to the general public. On two occasions on each day the whole process of producing milk in a correct manner was demonstrated, and at other times the staff was fully occupied in answering inquiries by farmers and others interested.

Farmers' Milk Competition.—A milk competition, which was conducted outside the show ground but in connection with the show, is worthy of mention, namely, the Farmers' Milk Competition. In this, prizes and awards of merit were offered to farmers who supply milk from the counties of Leicester, Rutland and Northampton to anywhere within the city of Leicester. In this competition there were three classes—the first for farmers who are licensed producers of graded milk (Certified or Grade A); the second for farmers supplying 46 gallons of milk

and upwards per day in two deliveries, and the third limited to smaller producers supplying from 10 to 45 gallons per day. The prizes and awards of merit in connection with these competitions were awarded on a scale of points based upon the condition of the milk in respect of its chemical and bacteriological analyses as it arrived in the city. In all 22 entries were received for this competition.

Butter and Cheese Classes.—The competitive exhibits of dairy produce covered 6 classes for butter and 15 classes for various types of cheeses. On the whole, the competition in these several classes was less than might have been expected. In the six butter classes the total entries were 59, an average of rather less than 10 per class, and in the 15 cheese classes the total entries amounted to 144 or an average of 9.6 per class. The two classes best patronised were those for Stilton cheese, where the total entries were 17 and 19.

Following the procedure of several years past, the butter classes were judged on a scale of points designed by the Society. A card showing (*a*) the maximum scale of points possible to be obtained and (*b*) the actual points awarded by the judge is placed with each exhibit immediately the judging has been completed. The Society deserves commendation for the adoption and continuance of this educational method of examining and deciding upon the merits of the respective exhibits in that the system shows to those interested, and especially to the competitors themselves, the reason for success or failure as the case may be. It is the means of turning what is often a competition with no educational value into one of material assistance to producers. The scheme is capable of much wider application than is generally practised. It might, for instance, be applied with almost equal advantage to the judging of the cheese competition. The scale of points used is as follows:—

Aroma and flavour ...	50 points.
Texture	15 „
Grain	10 „
Colour	15 „
Appearance and finish ...	10 „
	100 points.

Ministry's Exhibit.—As usual at this Show the Ministry had a pavilion in which were exhibits illustrating various matters of importance to farmers, *e.g.*, clean milk production, agricultural credit, small live stock, insect and fungus pests, seed testing, weeds, rat destruction and other subjects.

THE SOURCE OF OUR SEED SUPPLY: WITH SPECIAL REFERENCE TO CLOVER AND GRASS.

C. B. Saunders,
Late Director of the Official Seed Testing Station.

One of the provisions of the Seeds Act, 1920, requires a statement to be made in the case of a sale of certain kinds of seed regarding the country of origin. The main object of this is to place in the farmer's hands information which may be of value to him. It is generally recognised that home-grown seed, when available, is likely to give the best results in the majority of cases, though for certain purposes special foreign strains are sometimes favoured, and for these reasons the farmer should be interested in the origin of his seed.

A casual inspection of a seed merchant's catalogue will indicate that various British possessions and foreign countries supply the farmer with much of his seed, but there is no readily available information regarding the part played by imported seed nor are there any collected figures which show what proportion of this imported seed is supplied by the different seed growing countries. For this reason some attempt is here made to bring together the rather scanty statistical data available on the subject, and, with the help of information from other sources, to give some general idea of the present position of our seed supply. It is not proposed to touch upon the important side issue of the special advantages of home-grown seed and the desirability of increasing the home output.

Imports of Seed.—Before coming to the main question for consideration it is desirable to refer briefly to the volume of the external commerce in seed of the United Kingdom. The figures in Table I summarise the quantity and value of the six categories of seed into which the Customs and Excise authorities divide our imports and exports. These figures have been extracted from the Annual Statement of the Trade of the United Kingdom and are at present available in this form for the years 1920, 1921 and 1922. Previous to 1920 a different classification was in use and the complete returns for 1923 are not yet published. Figures for cereals and pulses are not included in Table I since the returns make no distinction in the cereal and pulse statistics between seed for sowing and seed for human and animal consumption.

It will be seen that our total imports of seed are very considerable and amount in annual value to about 1½ millions sterling. Exports reach a total of just over half a million sterling. The bulk of the exports consists of seed described as "produce of the United Kingdom" but this probably includes some foreign seed which has been passed into warehouse and cleaned in this country.

Clovers bulk largely among the imported seed and the net income (import minus export) of this class of seed is about 6,000 tons a year. It will be noted that the value per ton of imported clover seed (see also Table II) is greater than that of exported seed and this is no doubt largely due to the export of low-grade seed and cleanings to the Continent. In the case of grasses the exports usually more than counterbalance the imports in bulk. This is due to the large export of ryegrass. As this seed is of lower value than most other grass seeds we naturally find that the ton value of imported seed is very much greater than that of exported seed.

We usually export rather more vegetable seed than we import, but the trade in flower seed and in vetches is almost entirely an import one.

Table I also shows the gradual decrease in the value of seed during the last three years. This can better be shown by comparing in tabular form the value per ton of the more important kinds over this period. See Table II.

Our main inquiry resolves itself into two questions:—

(*a*) From what countries and in what quantities is this imported seed obtained?

(*b*) What relation does imported seed bear to the home-grown supply?

It will be convenient first to discuss these two questions on general lines and subsequently to deal with individual species.

Countries of Origin.—The first question is answered to some extent by the Customs and Excise returns. The information here found, however, is only of limited value since there is no subdivision of the six groups of seed mentioned in Table I though, on the other hand, a fairly complete geographical subdivision is made. As the total amount of imported seed varies from year to year according to our home requirements it will be more convenient to express the quantities received from different countries as percentages of the total import. As mentioned above, figures for 1920-22 are available and those for the main groups have been reduced to this form in Table III. There will obviously be seasonal fluctuations in the exports of any variety

from any country, depending upon crop, local requirements and other factors but, taking one year with another, the figures show, on the whole, considerable agreement, and it is suggested that the mean of these three years will give a fairly good idea of the average position.

It must not be assumed that all seed imported from a given country is necessarily grown in that country, since there may be re-export to the United Kingdom of seed imported from another country. It appears, however, that over the three-year periods for which the figures are given any adjustment necessary to allow for this would be relatively slight except in the case of some of the Mid-European States. The difficulty in the latter case is avoided in the clover section of the Table by grouping Germany, Czecho-Slovakia and Austria-Hungary into one area, though separate figures are given in the returns. Some proportion of the Canadian export passes through U.S.A. ports and may possibly appear in the returns as produce of the United States. It should be noted also that some of the seed imported into the United Kingdom is re-exported, but the amount is relatively small and would not materially affect the percentage figures.

Table III only carries our first question part of the way, since the groups are not subdivided. It has been found possible, however, to dissect the clover and grass figures with a reasonable degree of accuracy with the help of official statistics and private information from some of the exporting countries, and thereby to obtain figures for each species representing the percentage of the total import coming from the more important sources of supply. These figures are given below under the variety subheadings. In the case of vegetable seed it was found impossible to get much statistical information and the figures given are mainly estimated.

Proportion of Seed Imported.—Whilst we have the official figures previously referred to for the import and export of seed there is unfortunately no statistical information regarding home production and consumption. With certain crops, like mangold, one could make a very close estimate of seed requirements from a study of the Agricultural Returns for acreage under different crops, but in most cases where this can be done the seed is almost entirely home grown and consequently the question of the part played by imported seed does not arise. The difficulty is with clovers and grasses, which form the bulk of the imports: any estimate of seed requirements based on acreage would involve

so many assumptions and possible sources of error that it could have little value.

When we come to home production of seed we have not even figures to form a basis for these assumptions. It will be understood, therefore, that it is impossible to advance an accurate statistical basis for an estimate of the relationship between imported and home-grown seed. Furthermore, this relationship will show a fairly wide seasonal variation for some kinds of seed, depending as it does upon the success of the harvest in the United Kingdom. In the case of each species, however, an estimate is made below and in the case of clovers and grasses it is probably not far wide of the mark where the supply comes from abroad either to a very large or to a very small extent. It is given with greater reserve in the case of seeds like red clover or dogstail where the preponderance of home-grown or of imported seed is not very great and where the size of the home-grown crop is the deciding factor.

With these general observations we can now turn to the individual species. Under each heading will be found some estimate of the proportion that imported seed bears to the total requirements of the United Kingdom and also figures which represent the part played by the principal sources of supply. As previously explained the latter figures are based largely on statistical information except in the case of vegetable seed.

Red Clover.—The average import of red clover is from 3,000 to 3,500 tons, that is to say, it forms nearly half of our total clover imports. The amount of home-grown seed varies so greatly from year to year that opinions differ widely as to our average production. An estimate, that a quarter to a half of our requirements is imported, is therefore made with considerable reserve. The imported seed is almost all of the broad red type, as opposed to late flowering red, which is entirely home grown apart from small supplies from America and Scandinavia. The broad red clover is supplied by various countries in the following approximate percentages:—France 35, Chile 35, Mid-Europe 12, U.S.A. 9, New Zealand 5, other countries 4.

Alsike.—Only a small proportion, less than 10 per cent., of our alsike is home grown. Canada supplies at least 75 per cent. of our imported seed, and four-fifths of the remainder comes from Mid-Europe, particularly Czecho-Slovakia.

White Clover.—Genuine wild white clover is exclusively home grown, but one-half to two-thirds of the supply of ordinary white clover is imported. About two-thirds of the imported seed comes from Mid-Europe, *i.e.*, Germany, Poland and Czecho-Slovakia, whilst the remainder comes from the U.S.A. and from New Zealand, the former country sending about twice as much as the latter. The proportion of white clover arriving from New Zealand is likely to increase as its value becomes better known.

Trefoil.—Trefoil is almost entirely home grown, the imported seed from Germany and Holland forming not more than one-tenth of the total supply.

Lucerne.—There is not yet much lucerne seed saved in this country and probably quite 90 per cent. of the seed used is imported. Southern France is the main source of supply, the so-called Provence lucerne forming at least three-quarters of the import. A certain amount of seed comes from North and South America and the Mediterranean, but Turkestan lucerne, about which much was heard a few years ago, has largely disappeared from our markets.

Sainfoin.—A considerable amount of sainfoin is imported every year from France. This is mainly the giant form, seed of the common variety being largely home grown.

Birdsfoot Trefoil and Kidney Vetch are almost entirely supplied by France, whilst *Suckling Clover* is mainly home grown.

GRASS SEED.—*Perennial Ryegrass.*—Apart from a few hundred tons imported annually from New Zealand, at least 90 per cent. of our perennial ryegrass is home grown. Northern Ireland and Ayrshire are, of course, the principal growing areas.

Italian Ryegrass.—Probably about 80 per cent. of the Italian ryegrass used is home grown, this coming mainly from Northern Ireland. France (70 per cent.) and Denmark (30 per cent.) send us about a thousand tons annually, but the Danish supply seems to be decreasing, this no doubt being largely due to the increased attention devoted to cocksfoot.

Cocksfoot.—Cocksfoot is almost entirely imported, 85 per cent. of it coming from Denmark and 10 per cent. from France. A little comes occasionally from the United States, but the import from New Zealand, which was formerly considerable, has now almost ceased. The annual import is about 2,000 tons.

Timothy.—Timothy is also almost entirely imported though a little is grown in Scotland. The United States sends about 85 per cent. of the supply, whilst Canada sends 10 per cent. and Germany the rest. The annual import is from 1,250 to 1,500 tons.

Meadow Fescue.—About 250 to 300 tons are imported annually, of which 80 per cent. is Danish, and the rest is American and Canadian. There is no home-saved seed.

Dogstail.—New Zealand is the only country exporting this seed to the United Kingdom in any quantity, and the amount imported depends largely upon the volume of the Irish crop. On an average perhaps a quarter of the total supply is imported.

There is practically no home-saved seed of the following grasses:—

Rough-Stalked Meadow Grass is almost entirely supplied by Denmark, 30 to 35 tons a year being sent to this country.

Smooth-Stalked Meadow Grass.—The United States supplies the whole world with this grass, it being their Kentucky bluegrass. The annual requirements of this country will be in the neighbourhood of 30 tons.

Wood Meadow Grass.—This seed is obtained from Holland and Germany, the former country supplying the better quality.

Small Fescues.—Hard and sheep's fescues are mainly imported from Germany and its neighbouring states. These grasses are to some extent grown for seed crop purposes, and probably most of the seed reaching this country is so produced, but some seed is still hand collected from waste places. The import of Chewing's fescue (a form of red fescue) from New Zealand is not as great as it was formerly, largely owing to the loss of germination during the voyage to this country.

Bent Grasses.—The true creeping bent is largely hand collected in Mid-Europe and is usually of a somewhat mixed nature. Some of the other forms, such as Rhode Island bent, are cultivated in the United States, but as they are less valuable for British purposes the import is slight.

Meadow Foxtail is obtained mainly from Finland and Sweden, some seed also coming from Holland.

Tall Oatgrass and Golden Oatgrass are supplied by France (mainly) and Holland. The former is cultivated for seed purposes, but the latter is mainly hand collected.

Sweet Vernal Grass.—The best seed is obtained from Holland; the German seed, being largely hand collected, is liable to be mixed with the annual form (Puel's Vernal), which is quite useless.

ROOT AND VEGETABLE SEED.—*Crucifers.*—With the exception of cauliflower most of the field and garden crucifer seed is home grown, not more than 10 to 20 per cent. being imported for home use. A certain amount of cabbage, turnip and swede seed comes from Denmark and Holland, whilst cauliflower is imported very largely from Italy.

Mangold is mostly home grown.

Beet.—The amount of home-grown beet is increasing owing to the unreliability of some of the foreign stocks. About a quarter of the supply still comes from France (mainly), Holland and Denmark.

Carrot and Onion.—About 80 per cent. of the seed of these crops is imported, mainly from the U.S.A. and France. Some carrot seed is also received from Denmark and Holland.

Parsnip is mainly home grown.

**Peas.*—Maples and Greys are mostly home grown, but of the culinary varieties about two-thirds of the supply is imported, the U.S.A., New Zealand, Canada, and latterly Japan, being the principal sources.

**Beans.*—Field and broad varieties are mainly home grown; a small quantity of broad bean seed, however, is supplied by Spain, Morocco and Holland. About half the supply of runners is imported, Holland and, latterly, Poland being the main producers. Most of the dwarf bean seed is imported, France, Australia and British East Africa supplying the bulk of our requirements.

* These are not included among the vegetables in the Tables.

TABLE I.—AMOUNT AND VALUE OF IMPORTED AND EXPORTED SEED FOR THE THREE CALENDAR YEARS, 1920, 1921 AND 1922.

	1920.		1921.		1922.	
	Tons.	Thousands of £.	Tons.	Thousands of £.	Tons.	Thousands of £.
IMPORTS.						
Clover	7,219	1,263	7,253	798	6,848	575
Grass	6,977	752	5,327	481	8,848	553
Vegetable	2,275	287	1,495	162	1,970	170
Flower	301	72	186	54	151	37
Vetch	379	10	284	7	3,880	73
Other sorts	5,594	372	715	63	1.035	67
Total	22,745	2,756	15,260	1,565	22,732	1,475
	In 1923, 15,179 tons of Clover and Grass valued at £926,138 were imported.					
EXPORTS.						
Clover U.K. produce ..	1,005	140	727	63	732	46
" re-exports ...	1,037	191	507	58	330	33
Grass U.K. produce ...	7,804	296	7,201	230	7,945	252
" re-exports ...	481	60	475	54	255	23
Vegetable U.K. produce	2,192	298	2,227	223	2,701	173
" re-exports ...	297	54	207	43	741	65
Flower U.K. produce ...	51	20	41	16	39	11
" re-exports ...	6	1	5	1	2	1
Vetch U.K. produce ...	374	16	33	1	52	1
" re-exports ...	2	—	2	—	24	—
Other sorts U.K. produce	1,772	166	1,083	44	1,588	67
" re-exports ...	348	22	70	7	83	7
Total	15,369	1,264	12,578	740	14,492	679

TABLE II.—VALUE IN POUNDS PER TON OF IMPORTED SEED AND OF EXPORTS OF HOME-GROWN SEED FOR THE YEARS 1920 TO 1922.

	1920.	*1921.*	*1922.*
	£	£	£
Clover —Imports	175	110	84
" —Exports	139	87	63
Grass —Imports	108	90	63
" —Exports	38	32	32
Vegetable—Imports	126	109	86
" —Exports	136	100	64

In 1923 the value per ton of imported Clover and Grass combined was £61.

TABLE III.—QUANTITY OF SEED RECEIVED FROM THE PRINCIPAL SUPPLYING COUNTRIES EXPRESSED AS A PERCENTAGE OF THE TOTAL IMPORT.

	1920.	*1921.*	*1922.*	*Average of the 3 years.*
CLOVERS.				
France	33	26	15	25
Mid-Europe ...	20	12	29	20
Chile	10	27	16	18
Canada	13	15	20	16
U.S.A.	13	9	10	11
New Zealand ...	3	5	2	3
Other Countries ...	8	6	8	7
	100	100	100	100

	1920.	1921.	1922.	Average of the 3 years.
GRASSES.				
Denmark	40	41	29	37
U.S.A.	27	28	20	25
France	13	10	20	14
Germany	8	10	8	9
New Zealand ...	4	2	16	7
Canada	1	4	3	3
Other Countries ...	7	5	4	5
	100	100	100	100
VEGETABLES.				
France	26	29	54	36
Holland	20	27	22	23
Denmark	21	12	3	12
U.S.A.	11	6	4	7
Other Countries ...	22	26	17	22
	100	100	100	100
FLOWER.				
Holland	32	54	37	41
U.S.A.	32	31	25	29
France	12	8	19	13
Other Countries ...	24	7	19	17
	100	100	100	100

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ROTATION OF CROPS.

II.

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Development of British Rotations.—Under primitive conditions the earliest system of cropping would be continued cultivation of a selected piece of land with a corn crop, and the abandonment of this land when it became no longer reasonably productive. A new piece would then be cleared or broken up, and cultivated, until it in turn became too foul or exhausted. In some western districts, particularly in Wales, this method of cultivation continued until comparatively recent times. In the drier lowland districts of England, more suited for arable cultivation, and for maintaining a large population, permanent settlements and villages were formed even in early times. Regular rotations on the village farms were enforced under the Manorial system, and these continued with little variation on the open field from the time of the Norman Conquest to the middle of the eighteenth century. The most common rotation was as follows :—

First Year: Winter corn, principally rye and wheat.

Second Year: Barley, oats, peas, beans, flax, etc.
Third Year: Fallow.

The fallow given every three years enabled the land to be kept moderately clean, and to remain in cultivation for a considerable period, though the lack of adequate manuring kept production on a level which, judged by modern standards, was extremely low.

Three Course Rotations.—The basis of the old English three-course system can still be traced in some parts of the country on clay soils, where it is difficult to secure for roots the necessary fine seed-bed without great trouble and expense, and where folding the crop with sheep in a wet autumn or winter would be disastrous to the tilth of the soil for some time to come. On real clay soils even carting off a crop of mangolds may so seriously poach the land that it does not recover for some years. The basis of rotations on such soils is generally the fallow followed by two corn crops, the first of which is nearly always wheat. Generally, however, the proportion of fallow, which in the old system was one-third, is considerably reduced by taking a crop of clover, mixed seeds or beans instead of the fallow as frequently as possible, and also introducing a certain area of roots where there is a prospect of fair success. Such rotations are, however, not followed over any great stretch of country, as the inadequate supply of roots makes it difficult to convert the straw into manure, and the heaviest classes of soil have, in recent times, been largely laid down to grass. It may therefore be said that most modern rotations really date from the end of the eighteenth century, when the Norfolk four-course rotation came into general use.

Norfolk Four-Course Rotation.—During the latter half of the eighteenth century the cultivation of roots and red clover became part of the best agricultural practice, and these were incorporated in the Norfolk four-course rotation, roots—barley—clover—wheat, on which most of our systems are based, and which still persists unchanged in so many districts that it may be described as the typical English rotation. The cultivation of roots in rows made it possible on all but the heaviest soils to combine the benefits of the old bare fallow with the provision of a large weight of food suitable for the winter feeding of stock. This enabled the farmer to fatten cattle and sheep in winter, and to produce manure with which to maintain the fertility of his land. The introduction of red clover not only added to the stock carrying capacity of the farm, but also to its general

fertility. Clover, in common with other leguminous crops, such as peas, beans and vetches, is able to secure nitrogen from the air and the soil is thus enriched directly by the store left in its roots, and indirectly by the manure made by animals consuming the herbage or hay. In the case of phosphate and potash, the other important manurial ingredients, there is no similar means of making good the constant loss caused by the sale of crops from the farm. Many British soils contain ample supplies of available potash, but the majority are not too well provided with phosphates, so that the chief thing necessary on most soils to make the four-course rotation a perfect means of building up soil fertility is the addition of phosphatic manure. Towards the middle of the nineteenth century the extensive manufacture of superphosphate filled this need. On the lighter soils, where potash is often badly needed, the conditions necessary for full productiveness could not be completely satisfied until the discovery of continental deposits of potash salts later in the century.

Arrangement of the Norfolk Four-Course Rotation.—The exact arrangement and treatment of the crops in the rotation at the present time varies a little in different districts, but generally the root crop consists mainly of swedes and turnips, which may or may not receive farmyard manure, but are nearly always liberally treated with superphosphate or other phosphatic manure. Usually about half the crop is fed on the land to fattening sheep. In the dry climates and soils where the rotation is generally found, the succeeding crop of barley is not likely to be too heavy, and red clover is sown at the same time. A little Italian ryegrass, and some other kinds of clover are often sown along with the red clover, or, if there is any danger of clover sickness, a mixture, from which red clover is altogether excluded, may be substituted. In the following year the clover or seeds may be either mown for hay or grazed by sheep, the latter being perhaps the more common practice. In preparation for wheat, the clover is ploughed up in early autumn, and may first receive a dressing of farmyard manure. The wheat thus receives not only the farmyard manure, but also the nitrogen stored in the roots of the clover, and the residue from the manure of the sheep folded on the land two years previously, so that satisfactory crops can be grown even on comparatively poor light soils. After the wheat has been harvested, the stubble can be cleaned if necessary in preparation for the root crop in the following year. The straw of the corn crops is consumed or trodden into manure by fattening bullocks, which receive also

the portion of the root crop carted from the land, and a part of any hay which has been saved. With good average crops, half the roots are sufficient to enable the straw to be converted into manure, but if the root crop is a failure there may be a surplus of straw, and on the other hand, in an exceptionally good root year, it may not be feasible to get this proportion of roots consumed by bullocks. On the whole, however, as the rotation experiments at Rothamsted clearly show, the four-course rotation is very well balanced and enables the fertility of the land to be maintained with little expenditure on either manure or concentrated feeding stuffs. With good management and reasonable care in storing and treating the farmyard manure, the only necessary purchase from the point of view of farm fertility is phosphate, and sometimes potash for the root crop, though special circumstances may make it advisable to purchase other manures. Some small expenditure on feeding stuffs is usually necessary in order to avoid undue delay in fattening both cattle and sheep, and to secure the extra bloom and finish which often make a good deal of difference to the market price.

Modifications of the Norfolk Four-Course Rotation.—The four-course rotation in its original form is best suited for light or medium soils in a comparatively dry climate, and is thus found mainly in the east of England. It can perhaps be seen best in its original form on the Wolds of Yorkshire and Lincolnshire, though, with slight modifications, it may be found in all the eastern counties. There the climate favours the growth of wheat and barley of high quality; except on heavy soils the conditions generally are suitable for the folding of sheep; and the seeds, if left for more than one year, are liable to become thin and patchy, favouring the spread of couch.

Under other conditions it will generally be found that the original rotation has been more or less modified. Among the minor modifications, which need not be discussed at length, are such small changes as the substitution of mangolds for part of the turnips and swedes (owing to the greater susceptibility of mangolds to frost this is not done to any extent in Scotland); the substitution of oats for at least part of the wheat; the growth of an occasional crop of peas, beans or vetches in place of clover, when the latter has failed owing to drought, or when clover sickness is feared; and the fallowing of a heavy field when a wet autumn and winter have prevented any preliminary cleaning and have made it practically impossible to secure a satisfactory tilth for roots.

Five-Course Rotation.—A very common modification which requires special notice is the conversion of the Norfolk rotation into a five-year shift by the inclusion of an additional corn crop. It is difficult to improve on the four-course rotation as a means of keeping light land clean and productive, but its large proportion of roots requires a heavy expenditure on labour on all but the most easily cultivated soils, and the area of corn crops is only one-half the total arable. Although farmers, where possible, are endeavouring to open up other channels, the sale of wheat and barley is still much the most important and most dependable source of revenue available on the great majority of arable farms. It is natural therefore that on good deep soils an extra corn crop should be taken, particularly where grain of high quality and value can be grown. This not only increases the proportion of saleable crops from one-half to three-fifths, but at the same time reduces the area of roots from one-fourth to one-fifth. In such cases the second corn crop is almost always barley, and it is when so grown that the finest malting samples are secured. Not only does the previous corn crop remove any excess of nitrogen which would impair both the standing power and starchiness of the barley, but there is a good chance of obtaining a fine seed-bed and of sowing early, both extremely important factors in securing a uniform well-matured sample. The five-course rotation is thus usually: roots—barley or oats—seeds—wheat or oats—barley; but occasionally the two corn crops may be taken after the roots. This, however, is more common under the Wiltshire rotation mentioned later, where the root crop is also extended over two years and includes three or four foldings of sheep. On particularly good clean land the rotation may be extended to six years by taking two pairs of corn crops, but this is exceptional.

Rotations lengthened by leaving Seeds for two or more years.—In Scotland, Wales, and the north and west of England, where conditions are favourable for the growth of grass, and not so suitable either for arable cultivation generally or the growth of good quality wheat and barley, the Norfolk rotation is very often lengthened considerably by sowing a mixture of grass and clover seeds suitable for two, three or more year's ley, instead of the red clover intended for one year only. The length of time for which the grass is left depends almost entirely on the rainfall. In the north-east of England, and the eastern districts of Scotland, two years is a very common period, but in the wetter western areas the period is prolonged, and in west Wales it is often eight or nine years.

Under such conditions oats are by far the most important corn crop, though some wheat and barley may be grown, more for home consumption than for sale to miller or maltster. Spring oats, which are an uncertain crop in the drier southern and eastern districts, thrive well in the wetter, cooler climate of the north and west, and they do better than either wheat or barley on soils containing a good deal of organic matter, such as the newly ploughed old leys. The straw, too, is more valued for feeding than that of wheat or barley, and the grain is not so seriously affected by a long wet harvest. In a wet climate, grasses and other pasture plants easily establish themselves, and with suitable seeds mixtures and treatment, temporary leys are more productive than any but the very best permanent grass. When they are broken up after a period of years the store of plant food which has been accumulated by the herbage is gradually liberated, and fertility is thus maintained at a low cost.

Rotations including temporary leys are of special value in stock breeding and rearing districts. A certain amount of fresh grazing becomes available every year, and pastures which may have become stale or tainted are ploughed up. Moreover, good crops of hay can be secured from the young grass, and this enables young stock to be wintered cheaply.

Another important advantage of a fairly long temporary ley is that it enables couch to be kept down at little expense. In a wet climate the eradication of couch from arable land by the ordinary cleaning methods is a matter of great difficulty. If, however, a good ley is secured, couch usually disappears after four or five years under the competition of the grassy herbage.

The seeds are almost invariably mown for hay in the first year, and may be even mown in the second year, but in that case a light dressing of farmyard manure is usually given before the second hay crop is taken. If wild white clover either grows naturally or is sown in the mixture, a good close sward is secured by the third year. Under moist conditions this will continue to give valuable grazing for a few years longer, but on dry soils, or in a rather dry climate, bent grass and other undesirable plants increase rapidly and make it desirable to plough up after the third or fourth year. Oats are almost invariably taken as the first crop after the ley.

In a wet climate the folding of sheep in winter on roots does more harm than good, except on the very lightest soils, and for this reason it is usual to cart all the roots off the land. The greater part of the crop is fed to cattle, but some may be fed to

sheep on grassland. In addition to straw and roots a considerable quantity of hay is available for cattle feeding, and a large quantity of farmyard manure is thus produced, so that the whole of the root break and some of the hay crop can be given a good dressing. The residual effect of this is sufficient to produce a good crop of corn after the roots, and to give the young seeds a good start. With this system of farming one of the main considerations in maintaining the productivity of the farm is the securing of a strong growth of white clover in the later stages of the ley. It is advisable to sow a little wild white clover in the seeds mixture, and to use phosphatic manure liberally during the rotation to give it every chance of developing. If this is done there is rarely any need to incur large expenditure on nitrogenous manure or even purchased feeding stuffs.

An additional advantage of lengthening the rotation by means of a ley is that root crops do not come more frequently than once in six or seven years, and thus the risk of finger-and-toe is reduced to a minimum, provided that care is taken to avoid re-infection through the farmyard manure, or by carting diseased roots on to a field likely to be cropped with swedes or turnips two or three years later.

In hilly districts where some fields on the farm are too steep or inaccessible for manure carting, rape is often substituted for part of the root crop. It provides excellent food for the autumn fattening of sheep, requires little labour, and the manure of the sheep consuming it takes the place of farmyard manure to a great extent. Occasionally grass and clover seeds may be sown with the rape instead of in a corn crop.

Place of Silage Crops in the Rotation.—The great development of ensilage on arable farms during the last few years makes it necessary to mention specially the place usually occupied in the rotation by silage crops. In the majority of cases ensilage is adopted in order to reduce the area of roots where climate and soil make the cost of cultivation heavy, or make the crops very uncertain. Usually, therefore, a silage crop takes the place of a root crop. On heavy land an occasional bare fallow is still part of many rotations, and in such cases silage crops may take the place of the fallow. Mixtures of winter oats, vetches and beans are mainly relied on, and are sown in the autumn preceding the year in which the root crop would normally be taken. It is important that such a mixture should be sown fairly early, so as to become

well established before the winter, and this reduces the time available for cleaning the stubble. In order to overcome this disadvantage it is customary to give a dressing of farmyard manure before sowing the crop, so as to favour strong growth which will largely suppress couch and other weeds. The crop is usually ready for cutting about July before annual weeds have shed their seed. Afterwards, the ground, if heavy, may receive a half or bastard fallow to clean it further and prepare it for wheat in early autumn; if the land is light, or for other reasons not suited for wheat, a crop of rape or even white turnips may be taken to provide sheep food in autumn. Provided that the silage crop is so treated and cultivated as to give a large weight, it is likely to be even more effective in maintaining the fertility of the farm than a root crop, as vetches or other leguminous crops form a large part of the mixture and increase the store of nitrogen in the soil. It is not so certain that the system will prove as effective as a well tilled root crop in keeping the soil clean, particularly in a wet climate, where a bastard fallow in late summer is not likely to be very effective.

Rotations including Catch Crops.—A catch crop is a quickly growing crop taken in the intervals of the ordinary rotation without seriously altering the main character of the plan of cropping. In the Norfolk four-course rotation, for instance, there is usually a long interval between the harvesting of the wheat crop and the sowing of the succeeding root crop. In an early district, the wheat may be harvested early in August, and the succeeding crop of swedes will perhaps not be sown until the following June. Where the land is clean, and of such a texture that there is no difficulty in securing a good tilth for the root crop, it is sound practice to sow as soon as possible after clearing the stubble a quickly growing crop such as rye, winter barley, winter oats, vetches, trifolium (crimson clover) or some mixture of these. Even white turnips, kale or rape may be sown in the same way. Given early sowing and good growing conditions in autumn such crops provide a considerable weight of green food which can be eaten off early enough in spring to allow of root sowing at the ordinary time.

Naturally the system is of greatest value in the south of England, where harvest is early, and root sowing is comparatively late, but even in other areas the principle may be applied in a slightly different form by sowing along with the corn crop Italian ryegrass, which is available for autumn and winter grazing, and also checks the growth of weeds and prevents the loss of nitrates from the soil in autumn and winter.

On some of the chalk soils in the south of England, notably in Wiltshire and Hampshire, the catch cropping system is developed to a great extent, and there a rotation of the following kind may be adopted. This is often described as the Wiltshire Rotation, though it is frequently modified considerably according to the exigencies of seasons and food requirements of stock. The essential feature is the inclusion of two years' root crops followed by two corn crops.

1st Year	Catch crops, *e.g.*, winter vetches, followed by late sown turnips.
2nd ,,	Swedes.
3rd ,,	Wheat.
4th ,,	Barley.
5th ,,	Catch crop, *e.g.* rye, followed by roots.
6th ,,	Barley.
7th ,,	Seeds.
8th ,,	Wheat.

The catch crops, and most of the roots, are eaten on the land and the seeds may also be grazed, so that the sheepfold passes over the land five or six times in the course of the eight years. On the poor light soils where this rotation is followed there is no better means of maintaining fertility.

Rotations followed in Potato Growing Districts.—Where potatoes are grown on a small scale the simplest and most common plan is to devote a part of the root area to the crop. The methods of cultivating and manuring potatoes are somewhat similar to those adopted in the case of the roots, and a small part of the root land can be devoted to potatoes without seriously affecting the rotation. Where a considerable area is to be grown it is necessary to make some modifications in the rotation as a whole. Unlike root crops, potatoes are sold off the farm, and thus do not contribute in any important measure to the supply of farmyard manure, while, at the same time, it is generally desired to give them a liberal dressing of such manure in order to secure good crops. In introducing potatoes into the rotation it is necessary therefore to make other modifications which will ensure a maintenance of the supplies of farmyard manure. In some cases as, for instance, in many districts of the north of England and Scotland, this is done by carting off practically the whole of the root crop for fattening cattle, and in effect potatoes are substituted for the proportion of the root crop which, in the original rotation, would have been eaten on the land by sheep. As much as one-half of the root break may in this way be devoted to potatoes. Where this plan

is adopted, seeds are usually left down for two or more years, so that there is generally a good supply of hay, which, consumed on the farm, enhances the value and increases the quantity of the farmyard manure, and the leaving of the seeds for two or more years adds to the general fertility of the soil.

If it is desired to have a proportion of potatoes greater than about one-tenth of the arable land it is advisable to adopt a different plan. One of the best rotations for this purpose is that followed in East Lothian and other districts of Scotland, and occasionally in England. The East Lothian Rotation is as follows: roots—barley—seeds—oats—potatoes—wheat.

This rotation allows of one-sixth of the arable area being cropped with potatoes, and at the same time provides one acre of roots to every three acres of straw. This is less than in the Norfolk four-course rotation, where there is one acre of roots to two acres of straw, and this is compensated for by carting off more than one-half the roots for cattle feeding. Moreover, in the districts where this rotation is practised good crops of roots can be secured practically every year, and there is thus rarely any difficulty in getting the straw turned into manure. This rotation is sometimes shortened by cutting out the oat crop and taking potatoes immediately after the seeds. This gives the potatoes an excellent chance, as they thrive particularly well on land containing decaying herbage, and in such cases they may be grown without farmyard manure, artificials alone being applied.

In districts where, for special reasons, it is desired to have the maximum area of potatoes, other rotations may be followed. An extreme case is the practice in coastal districts where very early crops can be secured as, for instance, in Cornwall and Ayrshire. There, early potatoes may be planted nearly every year, but it is necessary to secure from outside the means of maintaining the fertility of the land, for instance, by obtaining seaweed or town manure, though a good deal can be done by sowing or planting suitable catch crops, such as Italian ryegrass, rape, etc., after lifting the potatoes, and either ploughing in these crops or folding them off with sheep.

Dunbar Rotation.—In a limited area of East Lothian, near Dunbar, potatoes have a special value owing to their cooking quality, and the fact that they can be re-heated when cooked without loss of colour. There, the following rotation is practised: Potatoes—wheat—clover and ryegrass—potatoes—swedes and turnips—barley.

It will be noticed that from the point of view of farmyard manure this system is not well balanced, and the deficiency is made good by the purchase of town and other manure. A somewhat similar system of rotation may be followed in the neighbourhood of towns where there is a demand for straw and ryegrass hay as well as potatoes, viz., wheat—seeds or ryegrass—potatoes.

Here, everything is sold off the farm, and the fertility maintained by the purchase of town manure. Red clover could not be grown every three years, so that such a system is limited to areas where there is a ready demand for ryegrass hay or green ryegrass. In the Fen districts surrounding the Wash, there are large areas of peaty soils where farmyard manure is not required, and here a similar three-course rotation, viz., potatoes—oats—wheat, is frequently followed. Generally speaking, however, in the Fen district there is no very settled rotation. The cropping is largely regulated according to the anticipated demand and special crops of all kinds, for instance, rape seed, mustard, vegetable crops, sugar beet, may be taken if there seems likely to be a good demand, or may be grown under a contract to supply a merchant at a given price. Artificial manures are liberally applied where deemed necessary, and farmyard manure is a minor consideration on the particular type of soil, which already contains an excess of organic matter and of available nitrogen.

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AGRICULTURAL EDUCATION IN CORNWALL.

W. BORLASE, N.D.A.,
Agricultural Organiser for Cornwall.

THE passing of the Technical Instruction Act, 1891, whereby money derived from taxes on spirits was devoted to technical and manual instruction gave a great impetus to the teaching of science in Cornwall, and day and evening classes were established in many parts of the county.

Evening Classes in Agriculture.—In 1900 Dr. J. Clark, then the newly-appointed Principal of the Truro Technical Schools, conducted very successful classes in agriculture both at Truro and at Liskeard, and in 1901 similar classes were opened at four other centres—Penzance, Helston, Bodmin and Launceston. The writer acted as teacher of the five classes

outside the Truro area from their inception; for the first three years under the direction and superintendence of Dr. Clark, but from that time to the present with full control of the whole of this work in the county.

There were, of course, difficulties from the beginning, and prejudice was common. Scientific facts and theories were received with something more than doubt, and when argument failed them one could depend on hearing someone among the unconvinced express a keen desire to see the teacher "try to run a farm." Science and practice were considered to be opposed to each other, and a union of the two impossible, or, if possible, useless.

At one or two centres the classes opened promisingly with satisfactory numbers, while at some others there were so few that the question whether to continue or close down was always present. In the second year, moreover, the problem of providing single handed for both the new students and for those who had attended the first course and now required something more advanced was naturally a worrying one. The third year brought some relief—a student who had passed through an agricultural course was engaged as an assistant and the outlook became more encouraging, the attendance improved and better and more systematic work was done. There were two or three changes of assistants between this time and the year 1905, when Mr. Alex Gregg was engaged as teacher of Agricultural Chemistry, and the work became, by the help of his wider knowledge of chemistry, a more valuable aid to the farmer and student. Some impression was evidently being made by this time on the minds of the farming community, for requests for classes came in from other parts of the county and another increase of staff was necessitated by the opening of additional centres of instruction in 1906.

Progress was fairly continuous from this time onward, and when any class was closed from lack of numbers there were always two or three districts anxious to welcome the staff. In the session 1911-12 there were no less than 14 classes with something like 300 students on the registers who were being taught by four full-time and four part-time teachers. Development continued regularly until 1914-15, when there was a serious set-back which became so severe in the next session that all the classes were closed except that at Truro. Staff and students had more serious work to do, and it was not until 1918-19 that a fresh start was made with a staff of one part-time and

three full-time teachers. The number of classes and of students has not yet reached the high water mark of 1914, chiefly from lack of staff, but better work has never been done than at present, and the growth of what may be called good feeling between farmers and teaching staff has never been so evident and so real as to-day. Doubtless there are still many who scoff at the idea of men who are not "practical farmers" being able in any way to render them assistance, but they are never heard in the open, their presence is never felt at public meetings or lectures, and everywhere one finds a very genuine wish expressed for more information by means of classes, public lectures, and Press articles. Inquiries on matters of agricultural interest and difficulty arrive by post or through interviews at the rate of about ten per week in addition to the many questions which are answered at the hundred-odd public lectures given in the course of the year.

Curriculum.—From the commencement each class has, as a rule, met on one evening of the week from 6 to 9 p.m. At first this time was divided into three equal periods, one hour being devoted to each of the subjects—agricultural botany, zoology and chemistry, but when an assistant was engaged for the teaching of practical agricultural chemistry it was considered that 1½ hours should be given to this subject and the other half to one or more of the branches of agriculture. This arrangement was found to work successfully and has continued to the present time. Students have always been encouraged to do some home-work and a fair proportion has responded every session. The home-work consists in identifying seeds in a mixture given them, in studying the notes of the lesson for the week, and in answering from three to four questions framed on the work of the preceding month. Criticisms on this home-work are made at the commencement of the agriculture lesson the following week, when the corrected papers are returned to the students.

A typical evening's work would be somewhat as follows:—

Stage I.—6.0 to 6.15, examination of agricultural plants—grasses in bundles, clovers, etc., mounted when green specimens are not procurable—with brief notes;

6.15 to 7.15, very full notes of the lesson distributed and the lesson given, questions answered as the lesson progresses;

7.15 to 7.30, criticism of home-work received the previous week and now returned; questions given for coming week's home-work, with a mixed sample of seeds to be named;

7.30 to 9.0, practical agricultural chemistry, as far as possible based on the lesson just given in the lecture-room. Usually

half-an-hour's theory followed by an hour's practical work. One or two questions set for home-work.

Stage II (*or Stage III*).—6.0 to 7.30, chemistry; 7.30 to 9.0, agriculture similar to above.

In 1907 a request came from some advanced students for a course in agricultural botany, zoology, and land surveying and mensuration. A class for such men was held on one afternoon of the week at one centre, and in following years this was extended, the whole of the day being given to this more advanced work, with geology and book-keeping added to the above subjects. These courses proved attractive to the more successful students and were well patronised, but the events of 1914-15 were fatal to this as to many other forms of useful work and they have not yet been resuscitated.

Syllabus of Work.—From the first students have been encouraged to prepare for an examination. Nothing so steadies a student and keeps him up to the mark as the knowledge that there is an examination at the end of the session for which he is expected to prepare. And when a young student has successfully taken the examination of the Elementary Stage, if his ambition has been carefully nurtured he will be eager for the next fence, and will not be satisfied while there is anything ahead which he can overcome. It is in this way that students have been encouraged to attend the class year after year, and frequently the question has been put to the teacher, " Are there no other examinations we can take? "

Up to the year 1911 the syllabus of the Board of Education was followed and a great many sat for the examinations every year. This was an excellent syllabus, commencing with plant life in the Elementary Stage, going on to soils, manures, crops, stock, foods and the feeding of animals in separate sections in the Advanced Stage, and adding to a more thorough knowledge of all these, a very practical examination on a farm in the Honours Stage. When these examinations were discontinued in 1911 the writer was asked by the Examination Committee of the Union of Educational Institutions to prepare a syllabus in agriculture and the result was one on the lines of that of the Board of Education, providing a three-years' course of instruction. The work of the course is divided as follows:—

First Year.—Plant Life and Soil; *Second Year*.—Manures, Crops, Diseases and Pests; *Third Year*.—Stock, Foods, Feeding of Animals, and Farm Economics.

This has been adopted and followed in all our classes. The

majority of the students who have worked carefully and systematically through this syllabus attend for four winter sessions; they find sufficient of value and interest in the third year's work to make it worth their while to do it again. Students who have come back for the fifth year are not at all rare, but usually some variation in the work is attempted for their sakes. At two centres during the past session, 1923-4, these students have been encouraged to form themselves into discussion societies, a paper on an agricultural subject being prepared each week by the students in turn, and the reading of it followed by free discussion. This has proved quite a success and will be developed in the future, as at nearly every centre there are a few students who have passed through the course and who are yet unwilling to leave while there is anything they can study. The discussions will prove most valuable to them in many ways and their usefulness will be increased by inviting other farmers to attend and take part.

Examinations.—No compulsion of any kind has ever been exercised to induce students to sit for examinations, and the numbers taking them vary from year to year. Thus in 1913 there were 80 who sat for the examinations of the Union of Educational Institutions, and 91 in 1914. This year there were about 60 out of the 200 students in the classes. The proportion is usually about 35 per cent. of those attending, but it must be remembered that many students are not very regular, some not well educated, and also that no other county ever presents *any*. Before 1912 the great ambition was to take and pass the Honours Examination of the Board of Education, but the standard of the examiners in both the preliminary written examination and the practical which followed was so high that the number of those who succeeded was never very high and there were generally more failures than passes. A very fair proportion of the successes came to Cornwall and in the results of the four years, 1907-1911, we find that of the 18 who passed, 11 were students of our Classes. In 1910 a desire to qualify for N.D.A. examination was expressed by a few of the best of the students and a Day Class was held at one centre (Truro) on one day of the week for the work of preparation. The class was attended by about a dozen young men from all parts of the county and in the examination of April, 1911, we secured two or three successes. Each year after this saw the success of one or two from Cornwall until the Examination Board made an alteration in the rules which excluded practically all but

those coming from agricultural colleges. Students have also been prepared for the examinations of the Royal Horticultural Society, both the Teachers' and the General Examinations.

During the last four years competitions in the judging by points of stock, cereals and roots and the identifying and valuing of foods, manures, seeds, etc., have been held by some of our Christmas Fat Stock Societies. These have proved very popular and last year the entries at the three centres (Truro, Helston and Wadebridge) totalled 360. At the show this year of the Royal Cornwall Agricultural Association similar competitions were held for the first time, and for these there were about 100 entries.

Type of Students.—As Cornwall is a county of small-holders, 85 per cent. of the farms being less than 50 acres in extent, the sons of small farmers predominate in the classes, but though all classes are represented probably a larger percentage of the farmers with over 100 acres than of the small-holders send their sons to us. Gardeners and school teachers are also represented. The majority are from 20 to 30 years of age, with a fair proportion from 15 to 20 years, while a few from 30 to 50 years may also be found. Women are not excluded and there are frequently one or two to be seen with the men, and they are on the whole quite as successful in every way as the latter. There is now an increasing number every session who have had a year or two at the County Secondary Schools and the progress made by such students is much more rapid. The extra year or two at school has not only enabled them to retain the information gained at the elementary school but the scope of their minds has been widened by their introduction to other subjects, such as chemistry and physics. Where a youth has left school at 14 and comes into the class at 17 or 18, having done nothing educationally in the interim, the labour of teaching him is far greater than in the case of those who have never dropped their studies.

Many of the students travel long distances to attend the classes but assistance is given to those who live more than three miles from the centre, and this allowance is increased if the distance is over six miles. For the last year or two an increasing use has been made of the motor 'bus and char-a-banc in bringing students to the classes, and this will doubtless be developed in the future. The County Council pay about three-fourths of the cost, the students the remainder. It is much more economical to bring in students from distances of 12 to 15

miles to one convenient centre than it is to establish a large number of small classes with all the expense of staff, apparatus, etc.

Other Educational Activities include the giving of public lectures of which there were 100 in the session 1923-24. Very frequently the giving of one lecture is followed by a request for others and often a short course of six or eight results. The demand in this direction is beyond the power of the present staff to supply and development of this form of instruction is possible. In addition to the public lectures there is the Advisory work which continues to increase and at present fully occupies the members of the staff every morning of the week. Soils, manures and foods are tested and reported on free of cost, and questions of all kinds are dealt with.

At the agricultural college for the province—Seale-Hayne College, Newton Abbot—eight reduced-fee places are allowed to applicants from Cornwall each year, and usually there is rather keen competition for these, which is increasing as the work of the college becomes better known.

In conclusion one may, perhaps, be allowed to express pleasure and satisfaction at the end of 24 years' work—in which every member of the staff has loyally co-operated—at being able to see and feel that one's efforts have not all been in vain and that one has been privileged to assist in helping onward the work of agricultural education in one's native county. The pleasure is greatly enhanced by the abundant evidence that the agriculture staff are individually and collectively looked upon as the farmers' friends.

Dairying.—The claims of the dairy farmer to assistance by means of technical instruction were recognised as long ago as the year 1892 when travelling dairy schools were initiated. In 1898 the Secretary reported: " The travelling dairy school has visited the whole of the dairy districts of the county, and there can be little doubt that it has been of considerable benefit. . . a very considerable and beneficial change has taken place in the dairy industry of the county."

The travelling dairy schools have continued in existence to the present day, and although the dairy organiser has now the assistance of two full-time teachers, it is impossible to meet the whole of the demands for classes and courses of instruction.

During the war classes for instruction in cheese-making were first introduced, and in spite of the opinion of many so-called authorities that it was impossible to make cheese in Cornwall

the attempt proved so successful that it has been continued, greatly to the benefit of all concerned. Co-operative cheese factories have been established in several places and have proved useful in assisting to dispose of the products of the members.

The work of this department at present embraces the holding of classes for instruction in butter and cheese-making, and milking; advanced classes for instruction in the above subjects as well as in the feeding of cows, the testing of milk, and poultry management; advisory work, including visits to farms and attendance at shows in connection with competitions in butter-making, milking, etc. It is safe to say there is no branch of technical instruction which is more popular in the county than that of the dairy department, and the numerous championships and other prizes which have been won in the open classes at all the leading shows of the country afford sufficient evidence of the high standard which the work has attained.

Horticulture.—One would naturally expect that horticulture would occupy a most important position in a county possessing the equable climate which Cornwall enjoys, and accordingly the County Council, as early as 1896, appointed a horticultural instructor. Fruit plots were laid down at Penzance, Truro, St. Austell, Launceston, Penryn, Callington and Bodmin, and lectures and demonstrations were given throughout the county. For some reason, however, the interest quickly waned and the demand for demonstrations almost entirely ceased. It may have been that orchards were laid down on unsuitable sites or varieties planted which were not adapted to the climate, soil, or requirements of the county. Be that as it may, in 1905 Cornwall was without a horticultural instructor and remained without one until 1920.

In the long interval 1905-1920, during which Cornwall had no horticultural instructor the wants of the horticulturists were not entirely neglected. Courses of lectures, often accompanied by demonstrations, were given by local gardeners, some of whom were well qualified for the work. The fruit plot at Penzance (Gulval) remained in the hands of the County Council, and under the superintendence of a competent horticulturist valuable work was done, such as the production, by selection and crossing, of suitable varieties of broccoli; the manuring of potatoes to determine the most profitable amount for first earlies, &c. This plot continues to supply us with useful lessons which are of direct benefit to the people of the district, and which are also

becoming increasingly appreciated and valued by the growers around. It is hoped that in the near future an experimental fruit plot will be laid down in the eastern part of the county which will be able to deal with the local difficulties of growers in the Tamar Valley.

In 1920 a Horticultural Instructor for the county was again appointed, and from that time there has been a noteworthy development in the work of the department. Short courses of instruction in horticulture, public lectures and demonstrations have been given in all parts of the county; advice on all varieties of subjects connected with the work is being sought and given; school gardens are being inspected and, wherever possible, new ones laid out. Experiments with broccoli, potatoes, &c., are being carried out.

Last March a horticultural commercial show was held at Penzance and was a great success. The idea of such a show originated with the horticultural superintendent, and was carried out under the auspices of the County Horticulture Committee working in conjunction with a strong local committee. There were excellent exhibits of commercial spring flowers and vegetables, and demonstrations in packing and grading produce were given by experts from the Ministry of Agriculture. Papers and addresses on subjects dealing with the growing and marketing of vegetables and flowers were given, and very helpful discussions followed. The show was in every way most successful, and it is hoped that there will be developments in many directions when it is held in 1925.

Poultry.—A great deal of valuable work has been done in the county in connection with the breeding and management of poultry. As early as 1897-8 lectures were being given throughout the county under the auspices of the county council and in 1900-1901 a well-planned series of experiments was carried out at Kernock, the estate of W. Hawk, Esq.

To merely enumerate the various experiments which were carried out at Kernock, and the results which were incorporated in Mr. Hawk's Reports, would occupy some considerable space and a description of them is impossible here. Even in 1900 there were experiments with various foods—maize, white oats, wheat, buckwheat, dari—to determine the most profitable one for egg production. Egg-laying trials were continued through 1901 to 1905 with various breeds; the effects of free range *versus* confinement were tried in 1902-5 (with striking results in favour

of the free range); in 1902-5 a test of "Hens *versus* pullets" showed that the hen lays 47 per cent. less eggs than it did in the same time when a pullet. Trials with various foods and mixtures of foods were continued through the years 1903-1910 with valuable results; the trials on chicken feeding were commenced in 1903, and the question of which is the more profitable to produce—eggs or table fowls—was decided in the same year in favour of the egg-production with ordinary prices. The testing of pure-breds *versus* first-crosses was commenced in 1903-4; and the value of such additions to the food as rock-phosphate and sea-sand (containing a percentage of carbonate of lime) engaged attention. By this time the work had assumed such proportions and the results in many directions had become so interesting and valuable that a long report was written by Mr. Hawk for distribution in 1905. The work continued on very similar lines through 1905-10, and the results were fully described by Mr. Hawk in his "Poultry-keeping for Profit," which was distributed throughout the county in 1911.

In 1917 a start was made in supplying sittings of eggs and day-old chicks from two or three of the best breeds at reasonable prices. A poultry instructress was appointed in 1918 to take charge of the station, and to give advice to inquirers. This work developed rapidly, and in 1919 it was considered advisable to remove the station to Truro, this being more central. The number of incubators was increased to five and an assistant engaged to meet to a greater extent the demands for lectures on poultry management. The scheme of the Ministry of Agriculture for the supplying of eggs and day-old chicks at fixed prices from recognised good-laying strains was adopted, and each year many thousands were distributed.

In 1923 it was considered that this scheme had been at work sufficiently long to have supplied all poultry keepers with stock of high quality, and that for a time greater improvement could be effected through an egg-laying competition. The Champion Prize—a 50-guinea silver bowl—presented by the *West Briton* newspaper, went to a pen of "Rhode Island Reds," with 455 eggs to its credit in 182 days. The competition, with some additions, will be repeated in 1924-25.

There is at present a poultry instructor who is fully engaged the year round in visiting poultry farms and runs to give advice on the spot, in attending shows with exhibits illustrating various points in connection with the industry and in giving lectures on poultry management. During the period of the

competition—October to April—an assistant is engaged, thus leaving the Instructor free to devote his time to the duties mentioned.

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INSURANCE AND THE FARMER.

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To the extent that the risks of farming resemble those incidental to other forms of enterprise it is probable that the existing facilities for insurance are reasonably adequate. The two great risks common to all industry are fire and employers' liability for workmen's compensation, and the farmer who elects to run them himself does so deliberately and not because of any lack of opportunity for covering them. The great tariff companies and Lloyd's underwriters are eager for business of this kind, and the main consideration affecting the farmer is not how to get protection but how to secure that he shall not pay an excessive price for it. It may be argued that farming risks of the nature indicated are less than similar ones in urban industry; the chances of loss by fire may be less amongst the scattered houses and buildings of the country-side than in crowded centres; the risks to life and limb attendant on the handling of farm live-stock and simple agricultural machinery may be less than those confronting the industrial worker; attention, too, is often directed to the high ratio of the expenses of the tariff companies to their premium income, and to the magnitude of their profits. On the other hand, it must be borne in mind that, as regards fire, the organisation for the protection of property in rural districts is much less perfect than in urban areas, and that the chances of a total loss in the case of such things as crops in stack are greater. As regards expenses and profits the case for the companies may appear to be less strong, but even here it must be remembered that what the farmer wants is security; a slightly higher premium is of less importance than the certainty of recovery in the case of loss, and the history of insurance is full of examples of ventures which have come to grief through unsound finance. It is, however, well known that many successful companies, incorporated to deal with these risks at less than the tariff rates, have been bought out by the tariff concerns so soon as their competition became formidable. There seems to be room here for combination amongst farmers for the purpose of

mutual insurance against fire and workmen's compensation risks, so as to secure for themselves the advantages (if any) of the conditions under which their industry is practised, and to retain, either by way of reduced premiums or by cash bonuses, the profits of the business.

Co-operative Fire and Employers' Liability Insurance.— It is of interest to note that a movement in this direction was started some fifteen years ago by a group of Warwickshire agriculturists which has been attended with no little success, and which bids fair to develop, at its present rate of progress, into an enterprise of the first magnitude in the insurance world. It is a mutual society (the National Farmers' Union Mutual Insurance Society, Ltd.) financed by the issue of fixed interest-bearing debentures with no ordinary share capital, so that all the profits are available for the policy-holders after making the necessary allocations to reserves. The premium income shows a steady growth, and the expenses ratio compares favourably with that of other companies. The business is well spread between fire and employers' liability, and granted a continuation of conservative management the society should achieve its object, which is to secure to farmers the benefits of co-operation in the matter of insurance.

In passing, reference should be made to a much earlier venture in mutual assurance initiated by a group of Lincolnshire farmers some forty years ago—the Binbrook and District Farmers' Association. It started as a Glanders Insurance Association to insure its members against loss from this disease. The distinguishing feature was that it had no capital, either paid up or nominal, and that its members paid no premiums; but when a loss was incurred a levy was made upon all members, according to the acreage of their holdings, to compensate the one suffering the loss. Very few claims were made upon the association, and in 1912 it was decided to extend its operations so as to include mutual insurance against employers' liability. New rules were adopted under which membership was limited to persons approved by the Committee and occupying not less than four hundred acres of land. The occupations covered include all classes of farm labourers, blacksmiths, carpenters, machine-men, grooms and domestic servants on any member's farm, and a rate per acre is levied at the end of each year on all land to compensate members for all losses above the amount of £3, though in the case of a heavy loss provision is made for an immediate levy. If no losses are reported above the amount of

£3 no levy is made. At the present time there are thirty-nine members occupying between them about forty thousand acres. This area was fixed as the limit of the society's operations as being sufficiently large to allow the laws of average to apply without being so extensive as to necessitate any professional clerical work.

The Association has been completely successful for the purposes for which it was formed. In no year has the amount of levy equalled the amount which its members would have had to pay to an ordinary insurance company to cover their risks. Possibly its success may be due to the fact that its members are all friends farming for the most part in a large way and upon uniform lines, so that there is little variation in the nature of the risks as between member and member. Thus, the likelihood of an abnormally large loss to be spread over a very small association of persons is diminished. However this may be, the venture is an interesting departure in farmers' co-operation, and it is possible that there are other districts in which similar associations might be formed to the material advantage of their members.

Hail and Live Stock.—Following fire and employers' liability, adequate provision exists for certain other risks which are peculiar to the agricultural industry, such as damage to crops by hail, and loss by accident of valuable live stock. Most of the large companies will quote rates covering the destruction of crops, and the loss of animals through breeding risks or during transit; and here again the farmer's need is less to obtain facilities for insurance than to secure these facilities at the minimum cost to himself. This can be provided, as in the case of fire and workmen's compensation, by the formation of mutual societies or by joining those already in existence. Hail insurance is rather a special case, because the districts affected are limited, but the risk is known and if the rates are high a profit-sharing policy would secure a return of the excess to the policy-holder.

Diseases of Live Stock.—It seems, therefore, that the great question concerning farmers' insurance is not the ordinary liability to fire or accident, or the special liability attaching to valuable live stock in certain conditions, or to crops in certain districts, but the question of the protection of the ordinary live stock of the farm, both from the ordinary diseases and from

epidemics. Nothing is known statistically of the losses which farmers incur in the production of commercial live stock, but where figures have been kept, they indicate a position far more serious than many people realise. Mere insurance might hardly be expected to do much to save the industry from financial loss, but it would, of course, be a help and not infrequently a salvation to the individual; and what is of far greater importance, it would lead to the accumulation of evidence on the incidences of disease and to the organisation of treatment against it. This aspect of insurance has been given prominence by the Agricultural Tribunal of Investigation :—

" The co-operative insurance systems abroad have resulted in much information being systematically obtained of the incidence of disease and on this account alone it would be fitting that the State should endeavour through its Department of Agriculture to advance the system of co-operative insurance. The records of mortality even in a limited number of societies would give a better indication of the loss which annually takes place amongst live stock of the country than is at present available and would provide an index of the several causes of the loss. Thus, in France, there are published each year by the Ministry, tables showing the proportion of loss among the different classes of live stock and the causes of disease. But the immediate practical object is to give the farmer a greater security against the serious loss which may at any time befall him in connection with his stock. The matter is important, particularly for the smaller farmers where the loss of a horse or a cow may be a very serious matter, whilst among farmers both small and large the incidence of an epidemic may cripple his resources for years."*

Reference is made to the losses incurred during the recent outbreak of foot-and-mouth disease; over two hundred thousand animals of all kinds have been slaughtered and compensation amounting to nearly £3,500,000 has been paid, but this does not represent by any means the full loss to the farming community. Apart from epidemics, however, there is the question of risk from endemic disease of all kinds and from accidents, about which very little is known. At the Newcastle Show of the Royal Agricultural Society of England, in 1923, charts were exhibited, prepared by the City Veterinary Officer, Newcastle, showing the number of carcasses of animals condemned within the city during recent years, the figures for the year 1922 being as follows :—

**Agricultural Tribunal of Investigation*, Final Report, pp. 76–77.

CARCASSES OF MEAT CONDEMNED, NEWCASTLE-UPON-TYNE, 1922.

	Total Slaughtered.	Unfit for Consumption.		Tuberculous.	
		Whole Carcass.	Parts or Organs.	Whole Carcass.	Parts or Organs.
Cows	728	38	43	39	43
Heifers	9,083	24	29	21	19
Bulls	537	3	1	3	1
Bullocks	5,936	20	27	16	14
Total ...	16,284	85	100	79	77
Calves	2 847	31	—	—	—
Pigs	30,281	32	—	—	—

If figures of this character could be collected from all large cities it would be possible to get a definite idea of the risk of condemnation of fat cattle which is undertaken by farmers, dealers and butchers, and to assess the premiums which would be required to cover such risks.*

Cow and Pig Clubs.—In England mutual insurance against mortality of live stock exists mainly in the form of cow clubs and pig clubs. These are by no means widespread, and they exist to cater entirely for the smallholder and the cottager, to whom the loss even of one animal may be disaster. The area of their operations is frequently no larger than a single parish, and although with good management they perform useful service it is obvious that some scheme of federation would be needed to place them on a satisfactory financial footing, combined with a very great extension of the movement if insurance in this form is to be made available to the smaller members of the agricultural community in general.† Except that this form of organisation is indigenous, however, it is probable that a better machinery could be devised to meet the needs of all classes of farmers in this matter.

Mutual Insurance Abroad.—An examination of Continental experience indicates the importance attached by other nations to the question and also the difficulties of it. In every Continental country mutual societies for live stock insurance are general, and they have been fostered and very often subsidised

* *Journal of the R.A.S.E.*, Vol. 84 (1923), pp. 282–3.

† A series of articles on Cow and Pig Clubs was contained in Vols. XXVIII and XXIX of the Journal of the Ministry of Agriculture, (April 1921 to March 1922 and April 1922 to March 1923).

by their Governments. It should be noted, however, that great as their progress has been in contrast with what has been attempted in this country, the great majority of agriculturists have not availed themselves of the facilities provided. In Germany it is stated that only 9 per cent. of the value of horses, 3 per cent. of that of cattle and 3 per cent. of that of pigs were insured in 1913 (Cahill); in Holland the situation is considerably better, but the local variations in the numbers of animals insured are remarkable, the Province of Drenthe, for example, having 46 per cent. of the horses and 39 per cent. of the cattle insured and Limburg having 41 and 40 per cent. respectively, whereas these respective percentages were 2 and 2·5 in South Holland and 0·7 and 1·7 in Utrecht (Leopold). In Lower Austria about 25 per cent. of the cattle of the province were insured by the Provincial Live Stock Insurance Institute in 1913 (Kallbrunner). The organisation of societies differs, too, in the various countries. In Holland they appear to be entirely unfederated, whereas in France federation and re-insurance have been carried to considerable lengths. In all countries, however, statistics show that the movement is a progressive one and a great deal of valuable actuarial data has been collected and published forming a guide to future developments. As a commercial enterprise live stock insurance does not appear attractive. In Finland four large capitalist companies engaged in this work from 1911 to 1915 had an expenditure slightly in excess of their receipts, whereas mutual local associations during the same period had an income slightly in excess of their expenditure. The explanation offered is that the costs of management in the case of the companies far exceeds that of the mutual associations. The inference is that live stock insurance is a matter peculiarly adapted to co-operative rather than to joint-stock enterprise.

The wealth of published information accessible as a guide to action is quite remarkable. From almost every European country, from Sweden to Switzerland, from France to Finland, statistics are available for the expectation of loss for different classes of stock and for the ratio of expenses to income. The figures giving the progress of the movement are themselves most impressive, and the conditions for success and the causes of failure have all been made the subject of careful study. Both in France and in Germany experience shows that local organisations of a mutual character are most suitable for live stock insurance. By them expenses of management are kept down, and in a determined district the risks are practically the same, so that

the difficulty of working out a tariff is reduced. The objection to the local society is its financial weakness, due to the limited area in which it operates and to the small number of animals covered, but this can be, and very often is met by federation and re-insurance.

It is not possible here to do more than indicate thus briefly the scope and organisation of the live stock insurance business on the Continent, but it would well repay a careful study made with the object of considering its application to this country. A start might be made through the development and federation of existing insurance clubs, for their membership is mainly confined to financially small men, and, as Cahill has pointed out, "the importance of live stock insurance for farmers may be said to be in inverse ratio to the size of their holdings." It cannot be indefinitely neglected, however, by larger farmers.

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SYSTEMATIC FEEDING OF COWS IN WILTSHIRE.

E. H. BRUCE DAVIS and G. ERNEST HUGHES.

THE following article is based on the writers' joint experiences of the feeding of dairy cows according to the system advocated by the County Agricultural Organiser for Wilts.

They were the first two farmers in the county to put into practice the advice given by the organiser in respect of feeding, and the purpose of the article is to give first hand their experience of the results.

The writers got into touch with the Agricultural Organiser owing to attending a course of lectures commenced at Warminster in November, 1922, and they were so impressed by the lecturer's remarks that he was asked to supervise personally the feeding and management of their milch cows.

Basis of the System.—The Organiser laid it down in his lectures that—

(1) Cows should not go up in milk on going out to grass.

(2) Heavy milking cows should not lose flesh.

(3) Cake and meal ought not to exceed 3½d. per gallon at the then current prices.

(4) A maintenance ration equivalent to 20 lb. hay should be given (*i.e.*, 0.8 lb. digestible protein and 6 lb. starch equivalent).

(5) A production ration should be fed for each gallon of milk the cow is giving (standard 0.56 lb. digestible protein and 2.25 lb. starch equivalent).

(6) The total dry matter to be 27-33 lb.

(7) The cow should be prepared for her lactation period before calving (equivalent to 2 gallon ration).

(8) Strict attention should be paid to milking and daily recording as far as practicable.

(9) Concentrated food should be used in the maintenance ration for reduction of bulk in the case of heavy milkers.

(10) Roots should be dispensed with where they have to be bought. In any case not more than 50 lb. per day should be fed, and 30 lb. for preference.

(11) Chaff should be replaced by long straw.

The writers' farms differ in character, Farm A being a mixed farm on the greensand, one-third arable and two-thirds grass, and Farm B a totally grass farm on clay, adjoining the chalk. In both cases the grass is of good average quality.

Before commencing on this system, both herds had been recorded and attempts had been made to feed in accordance with yield. Both herds are non-pedigree Shorthorns, with a few Friesian-Shorthorn Cross heifers on Farm B.

As the cows had previously gone up considerably on going out to grass, and the heavy milking cows had always lost flesh, it was felt that the system hitherto followed had not been correct. As far as cake and meal were concerned, the cost had, in the past, been somewhere in the neighbourhood of 5d. per gallon so that if the cost could be reduced to 3½d. there would be an immediate saving of 1½d. per gallon, even if no increased yield was obtained. In consideration of the above, the writers decided to give the system a trial.

Rationing System.—The system of feeding then adopted on the two farms was:—

Farm A.	Hay 16 lb. Straw (long) 4 lb. Roots 30 lb.	*Farm B.*	Hay 20 lb.

and, in each case, a production ration per gallon. In the case of heavy milking cows, the bulk of the maintenance ration was cut down by replacing part of the hay by half its quantity of a mixture of bran and oats, and roots were cut down in the case of Farm A to 14 lb.

Farm B, prior to this, was purchasing roots at 25s. per ton and hauling 4 miles, feeding 25 lb. per day, but these were

discontinued at once; also a certain amount of hay was chaffed, and this was discontinued.

Farm A had also been feeding chaffed straw mixed with the roots but discontinued the chaff and fed the straw long.

The production ration consisted of the following:—

Farm A.	Decorticated cotton cake ...	1 part	feeding $3\frac{1}{2}$ lb. per gallon.
	Rice meal and oats ...	2 parts	
	Unextracted palm kernel cake	2 parts	
Farm B.	Decorticated cotton ...	$\frac{1}{2}$ part	feeding $3\frac{1}{2}$ lb. per gallon.
	Decorticated ground nut ...	$\frac{1}{2}$ part	
	Rice meal	2 parts	
	Unextracted palm kernel cake	6 parts	

also $3\frac{1}{2}$ lb. soaked coconut cake in the form of thick porridge was fed for the first gallon in the case of Farm B.

The writers consider it preferable that half of the production ration should be in the form of cake and of large pieces for preference. The reason why these particular foods were used was that they were the cheapest at the time. Heavy milking cows for every gallon over 5 and heifers for every gallon over 4 were fed with 2 lb. linseed and $\frac{3}{4}$ lb. bran per gallon.

Results.—As an immediate result, all cows increased their yields and maintained them more evenly throughout the winter; all the cows kept evenly fleshed, and at the end of the winter, cows never went out to grass looking better. Probably one of the most important factors was the preparation of the cow for her lactation period. This was done by feeding a laxative production ration for 6 weeks before calving, commencing with a 1 gallon ration at the six weeks and increasing to a 2 gallon ration at the month. This resulted in the whole of the cows coming down at calving at least a gallon higher than at any other previous period, so much so, that if a cow comes in under 5 gallons, it is an exception.

For this ration when cattle are out to grass and also when the hay on the farm is laxative palm kernel cake is used. Indoors, when the hay is not particularly laxative, 2 parts linseed cake and 1 part rice meal are given.

Milk fever is not feared as precautions are taken before the animals are calved and on neither farm has there been a case of milk fever.

At the commencement of the system, daily recording was practised to see the effect of the rations on the individual cows and to increase the food to those increasing in yield. This also enabled the writers to keep a check on their milkers.

On going out to grass, Farm A had a slightly increased milk yield—about 7 per cent.—but Farm B had a decreased yield of about 6 per cent., part of which was later recovered. In both cases cows were turned out to plenty of grass about the beginning of May.

At the end of the year, Farm A had an increased average of 50 gallons per cow and Farm B of 120 gallons per cow; in the former case the herd had been recorded for many years, whereas the latter was newly formed and had only been recorded for three years. On Farm A it is estimated that the decrease on the cake and meal bill, after making an allowance for difference in prices, was over £150 during the year.

Modification and Results in the Second Year.—After the experience of 1922-23, the writers were absolutely convinced of the effectiveness of the system, and preparations were made for the following winter by forward buying of feeding stuffs in collaboration with the organiser. During the last winter, more attention has been paid to dry matter by the cutting down of bulk of the maintenance ration, and in all cases the cows have been prepared for their lactations, this latter point being one that is most important. This preliminary feeding before calving is even more necessary for heifers than for cows, as is proved by the heifers in these two herds.

Also in the case of Farm A roots have been reduced to 14 lb. per day, although there were sufficient on the farm to have fed 70 lb. per day.

With one winter's experience behind them and the men being more accustomed to the work and at last being converted, the results have been even better than the previous winter—to be precise, the daily average has been increased ½ gallon per cow.

On Farm A, the average number of cows (including dry cows and 17 heifers) was 75, and the average daily yield during the winter was 200 gallons. On Farm B, the average number of cows (including dry cows and 19 heifers) was 60; the average daily yield during the winter, 170 gallons. The ration for the last winter, owing to forward buying, cost 3d. per gallon. At the present moment (at the end of 7 months) there are in herd B as many 1,000-gallon cows as there were in the preceding 12 months.

Experiments have been conducted on three times milking on part of the herds, the result being ¼ gal. increase per cow and 75 per cent. of cows responding. The effect was most marked on the heifers, some of which increased up to 1 gallon per day.

At the time of writing, Herd A has gone out to grass, and at the end of three weeks the yield is down 5 gallons per day. Herd B has only been out to grass three days, and the three times milked cows have shown a slight increase; these latter cows are kept in from 1 p.m. to 8.30 p.m., and have their cake ration for gallons over three during that period.

The system of summer feeding is :—a value is put to the grass (at present, 20th May, 3 gallons) and a balanced production ration fed for each gallon over three. The feeding value attached to the grass is altered as the season advances. A small quantity of cotton cake is fed to prevent cows being too laxative. In the fall of the year, the grass will be balanced up to 3 gallons by a concentrated cake.

From the writers' experience of this system of feeding, they are absolutely convinced of the efficiency of the system and are very grateful to the organiser for his advice. They are certain that every dairy farmer will be well repaid for any attempt he may make to follow the system.

The writers would like to emphasise the fact that from their experience it is not a question solely of feeding a balanced ration according to yield, but it is by attention to minor details of management that the best results are obtained. As far as their experience is concerned, they are convinced that the feeding of chaff is detrimental, the heavy feeding of roots is not economical or desirable, and the order of feeding the various fodders and concentrates is of material importance. The importance of the order of feeding is to prevent, as far as possible, the animal overfilling herself, as one of the essential factors in the Organiser's instructions is that the cow must not be overfilled. To get over this, the cake and meal is always fed before the bulky food, as, if this is done in the opposite order, the cow, being hungry, will eat a large bulk of hay and then consume cake and meal afterwards because she likes it, resulting in overfilling and a grunting cow; also, for heavy milking cows, three times a day feeding of concentrates is practised. The order, then, is as follows :—

5.30 a.m., ⅓rd cake and meal.
7 a.m., hay.
1 o'clock, ⅓rd cake and meal, followed by hay.
6 p.m., ⅓rd cake and meal followed by hay.
Watering three times a day, the last watering being at 8 o'clock at night.

The value of watering at 8 o'clock at night cannot be overestimated.

Although the writers were the first farmers in Wiltshire to commence this system, it is common knowledge that a large number of farmers are now doing the same with similar beneficial results, and in some cases with even better results than their own.

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CORNISH MARL EXTRA-LATE-FLOWERING RED CLOVER.

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THE red clover crop plays an important part in grassland improvement, but good seed of the proper strain is essential in order that crops may be uniformly productive over the whole duration of the pasture. In south-west England, where leys are left down for three years or more, the farmer complains that broad red clover seed does not give a lasting plant: in the first year a good crop is obtained, in the second harvest year much less, and in the third year only a few straggling plants. One of the chief reasons for the poor crops of red clover is the use of foreign seed from warmer climates, even though it is of better appearance and higher germination through not having been subjected to the adverse weather conditions which cause many British-grown samples to be shrunken and of a dull colour.

The clover trials conducted by Professor Stapledon at the Welsh Plant Breeding Station, Aberystwyth, however, have conclusively proved that British seed from a high-lying district with a cool climate is to be preferred to foreign samples, though the same high germination is not to be expected. The strain of the plant is more important than superlative germination.

A somewhat localised area on the wind-swept uplands of the north-west coast of Cornwall, around Wadebridge, has for many generations been famed for the persistence of the clover grown there. This gives good bulk throughout the whole three or four years of the customary duration of the leys; crops have been known to last ten years, and plants for longer periods. As red clovers of all nationalities are mixtures of highly variable natural hybrids resulting from cross pollination, it is remarkable that the strain has retained its purity for so long, and this can only be accounted for (1) by its isolated position, (2) by the fact that little late-flowering red clover from other districts is sown in Cornwall, and (3) by the fact that the growers invariably grow their own seeds in a manner that has brought about a continuous mass selection.

In preliminary clover trials with early- and late-flowering types of red clover, Cornish Marl clover has shown itself to be more persistent than any other strain of clover except Montgomeryshire Red—a strain grown in Wales which is very similar to that grown in Cornwall. The following data* show that it is capable of great winter hardiness and of giving high yields over a number of years.

Table I. Relative Yields of different Strains of Red Clover Compared with English Late-Flowering Clover expressed as 100.

Strain.	1921. 1st Harvest year.	1922. 2nd Harvest year.	1923. 3rd Harvest year.
Lates.			
English Late-Flowering ...	100	100	100
Cornish Marl	109.5	103	134
Earlies.			
Broad Red	107.2	55.6	39.8
Chilian	82.5	24.6	34·1
Italian	37.2	0	0

Its extensive root system, which penetrates to considerable depths, appears to give it a greater power of resisting drought than the Welsh strain, and in a season like 1923 it also showed itself capable on a light soil of giving a higher yield in the first harvest year than any other early or late strain.

The use of disease-resisting strains for all crops is becoming of increasing importance in controlling fungus pests, which tend to lower the clover returns considerably. In this connection it is interesting to note that there appears to be no other form of red clover so resistant to the attacks of *Gloeosporium caulivorum*, which has recently caused havoc amongst the clover crops on the Continent and in E. England, Italian clover being particularly susceptible to this disease.

Table II. Relative Susceptibility to Anthracnose of the different Nationalities of Red Clover.†

(The highest mark represents the greatest susceptibility.)

Nationality.	1920. No. of Lots averaged.	1920. Average Marks.	1921. No. of Lots averaged.	1921. Average Marks.
Late-Flowering Group.				
Cornish Marl ...	3	0.3	2	0.5
Montgomery ...	2	1.5	6	1.0
English Late ...	31	1.0	2	1·0
Early-Flowering Group.				
Italian	5	4.0	2	3.5
English Broad ...	39	3.0	1	4.0

* See Williams, R. D. Investigations with Herbage Plants at Welsh Plant Breeding Station.

† Preliminary Investigations with Herbage Plants at the Welsh Plant Breeding Station, Aberystwyth.

Trials with Cornish Marl clover are at present being conducted on clover-sick land in the eastern counties of England.

The Cornish soils are notably sour, and locally the clover has a reputation for persisting on such soils. Samples of soil growing good crops of Cornish Marl have been tested at the county laboratory and tend to substantiate this belief.

Cornish Marl is an extra-late-flowering strain of red clover, flowering about two weeks later than English late and three weeks later than broad red. It tillers very freely, and has a dense tufted habit. More stems are produced than in any other strain except the Montgomery red, and more side branches are produced, especially towards the top of the stem. It gives a very heavy single hay crop, but the aftermath is poor (with only an occasional plant in flower) unless the hay has been cut early, and there is little growth during the winter and early spring. Its outstanding qualification is its ability to persist for a longer time than any other kind of red clover except Montgomery red. Either might be used with advantage for three years or longer duration leys, whether hay or grazing be the object in view.

The plants and seeds of all red clovers are so much alike that the average farmer is unable to distinguish between them, and local seed merchants are not more successful with their seed. Many mixed samples are offered and disappointing results obtained. After two seasons' growth there is no difficulty in telling which has been sown, but unfortunately this knowledge will not help the farmer in purchasing his seed. Cornish Marl clover seed is smaller and not so bright as broad red; more seeds are provided per pound, but until the present year the seed was so unclean that it could not be regarded as a commercial proposition.

In March of this year a conference of all the principal growers at St. Columb decided to form a Cornish Marl Clover Growers' Association.* The objects are to guarantee the origin of the seed and retain the purity of the strain; to secure and provide for earlier threshing and cleaning operations so that the seed may be ready for market at the beginning of the season; to afford facilities for the testing of the seed under the Seeds Act, 1920, samples being forwarded to the Official Seed Testing Station, Cambridge; and to organise the marketing and advertising of the seed.

The co-operation of the local seed merchants has been obtained, and they have been allowed to become members on the condition

* The Secretary of the Cornish Marl Clover Growers' Association is T. Rowse Hosking, Town Mills, St. Columb, Cornwall.

that they only sell seed as Cornish Marl which has been grown by members of the Association.

It is intended to issue guarantee certificates to growers of the pure strain, and the writer, at the request of the Association, has assisted in inspecting the clover crops, in connection with the carrying out of his duties under the County Council. The growers of the pure strain are thus known, though the Association itself does not propose to issue guarantee certificates until the third year.

In order to maintain or even improve the persistency of the strain it is intended to obtain seed for seed purposes only from old leys, or those which have been down for at least three years, to be distributed to other seed growers, at slightly enhanced prices, for the extra trouble involved. Later on, the Association intends to register the stocks on the same lines as pedigree live stock societies.

Clover trials are being conducted at the Cornwall County Council plot with about twenty different nationalities of clover to compare their relative persistency and yield with the local seed under local conditions, with a view to selecting the best strains of Cornish Marl for seed-growing purposes.

The amount of seed available will vary with the climatic conditions prevailing in the west, but the increased acreage sown this year will aid in equalising supply and demand, which it is anticipated will increase as the Cornish Marl Extra-Late-Flowering Red Clover becomes more widely known. Less valuable clovers are being imported; our home-produced article could replace these and be of benefit to the grower and consumer alike.

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THE COUNTRY WHEELWRIGHT AND HIS OUTLOOK.

CONTRIBUTED BY THE RURAL INDUSTRIES INTELLIGENCE BUREAU.

History and Present Condition of the Trade.—For a long period, certainly since mediæval times, the wainwright or wheelwright has occupied an assured and outstanding place in the scheme of rural life. He was the maker of carts and wagons, and various other vehicles and implements used in agriculture and constructed chiefly of wood.

Coach and carriage building was, in this country at all events, a comparatively recent refinement of the craft, which started at

the latter end of the 16th century, and expanded to the dimensions of an industry only in the middle of the 18th century. To this branch of the trade the village wheelwright seldom or never aspired. On a higher plane as regards constructional skill, knowledge and special aptitude required, and for long a luxury trade rather than an essential industry, coach building naturally became an urban undertaking, and probably from the very first always tended to attract and absorb the more skilful, intelligent and progressive men. Businesses of this type were undoubtedly the forerunners or formed the nuclei of the extensive present-day vehicle building industry, which has been able to adapt itself in turn to the production of the stage coach, the hackney carriage, the railway carriage, and finally the motor car.

In the remoter rural districts, change has been slow to affect the wheelwright and slower still to be appreciated. Down to a generation or so ago, he continued to produce the article he and his little circle of customers were used to, and to employ the methods which had sufficed for his fathers before him. In recent years the decline of local industries has been more rapid, and at the present time the great majority of farm vehicles produced are factory made. Large numbers of carts and wagons of the old type are still in use after repeated patchings, and a certain proportion of farmers make a practice of ordering the hand-made vehicles, which they consider more reliable and more lasting. But these are the exception, and generally speaking, the country wheelwright's trade has reached a stage of depression beyond which its further existence is seriously threatened, if not rendered wholly impossible.

The Use of Motor Transport.—Various causes have contributed to this state of things. The rise and rapid development of the motor industry has certainly lessened to some extent the demand for horse-drawn vehicles in agriculture, and consequently for the wheelwright's services. The farmer's gig or trap has been largely replaced by the cheap car and, since the War at all events, his produce goes to market or to the railway station more frequently by lorry than by wagon. The horse-drawn vehicle has tended to become more and more restricted to the area of the farm itself, with the result that not only are fewer required, but those few are not so constantly used, and need replacement and repair less often.

Prospects of a Revival in the Demand for Horse Vehicles.—There are some signs, however, that the present wide preva-

lence of the use of motor vehicles is more of a temporary phase than a settled tendency on the part of agriculturists. It appears to have been overdone in several directions to the detriment of both economy and efficiency. At the conclusion of the War, agriculture had had several very prosperous years, second-hand Army lorries were abundant and cheap, and hope in progressive methods ran high. Since then, years of depression have come, and the source of supply of these vehicles has all but dried up. Their short life and high cost of upkeep, especially towards the end, to say nothing of the annual tax of £25, which has to be paid on vehicles of two tons or over, has so disillusioned many who invested in them, that they are little likely, even if they could afford it, to replace worn-out lorries with new ones costing £600 or £700 each. Though the motor vehicle in agriculture, in one form and another, has come to stay, and the demand for farm vehicles of the old type is unlikely to reach the old proportions, yet it may be expected to increase during the next year or two, and if at the same time agricultural conditions improve generally, it should again assume decidedly healthy dimensions. Signs are not wanting indeed that it has already begun. Many country wheelwrights may have noticed—one or two indeed have commented on it—that at sales of stock and implements, second-hand carts and wagons, some of them 30 or 40 years old, are eagerly bought up by farmers, fetching, often enough, prices which the wheelwright would be glad to get for a new one to-day. This suggests that a latent demand exists, waiting for those able to take advantage of it. The bulk of this work must be expected to go to the bigger manufacturers. But it seems very possible that as things now are, it might be worth while, for a country wheelwright who could afford it, in the intervals of his regular work, to build one or two carts or a wagon as a speculation without waiting for an order. The old skill has not yet died out, and when the vehicles have been built, a little wider and more favourable market than the nearest farmers provide might be reached by putting a small advertisement in some periodical connected with farming interests.

This is advertising in its most elementary form, and advertising must be an essential feature of any business which nowadays intends to manufacture goods for sale. Newspaper advertisements should be accompanied, wherever possible, by exhibits of carts and wagons at local agricultural shows. Those firms who do exhibit, have usually in our experience, found it

profitable in bringing them orders. Most customers naturally like to see what they are buying before they buy, and the county agricultural show provides a useful shop window at no great expense. Besides providing the nucleus of a rather wider market, freeing the worker from dependence on one or two local customers, such an experiment should show him clearly the very great advantage of being able to supply goods more or less ex-stock, instead of continuing the present indefinite delay in delivery, the result of waiting for an order before starting work. The inconvenience of this delay is a heavy handicap. It is enough by itself to keep potential customers away unless they can get absurdly low prices or long credit as a set off.

The Credit Question.—The long credit required by farmers is often said to be one of the chief causes of the collapse of the wheelwright's trade. No doubt circumstances have combined during the last few years to accentuate this old standing feature of the relations between the wheelwright and his principal customer. The long credit—6 to 12 months—appears to have been customary at least beyond all living memory, and any intensification of hardship from this source must be chiefly laid to the account of prevailing agricultural depression. It is decidedly contrary to present-day business methods, and the only way of getting rid of it is by effective organisation among wheelwrights themselves.

Ignorance of Business Methods and Undercutting.—In the inquiries which the Bureau has made, particular attention was directed to the business methods of country tradesmen, and it is clear from the information obtained that quite a large proportion of the master men in the rural areas, have little idea of what constitutes profit or loss on a job. Many seem to be quite contented if only they can get work to do, and to achieve that end are ready to undertake it at prices often enough bearing no relation to actual cost of production.

The worst effect of a blind readiness to cut prices is, of course, that during any prolonged period of depression and work shortage, it compels the many who know better to follow suit. In busy times the matter is of no importance. The output of those who habitually practise it would be very small and uncertain; the owner of such a business could seldom afford to employ journeymen, his own earnings being usually below the rates they would demand.

The Overhead Charges of the Factory and the Small Firm.—We have come across not a few wheelwrights who seem to be quite convinced that on account of very much lower overhead charges, the country shop can profitably build its carts and wagons in the old-fashioned way, at a price which will compete with the mass product of the factory. This is a point which is worth a little general consideration, and the wheelwright who proposes to manufacture should take careful account of it.

The overhead charges of the factory amount in the aggregate to a considerable sum, but, spread over the greater number of productive workers employed, they become reduced to quite manageable proportions. In a normally busy and efficiently conducted business of the sort they should not exceed 120 per cent. of the average labour cost, let us say, for example, 2s. per workman per hour.

The charges on a small country business are more difficult to arrive at, and in too many cases it is to be feared the owner concerns himself far less with the matter than he should. Whether realised or not, they are still there, and in the long run, if neglected, they are liable to make themselves unpleasantly conspicuous.

In a small country shop run by, say, its owner and one assistant, occupying premises of reasonable size and convenience for this type of trade, the following must be regarded as overhead charges—rent, rates and taxes, light, fuel, interest on capital locked up in stores and stocks of material, insurances, depreciation, allowances for replacements and repairs, non-chargeable time, bad debts, carriage costs and general business expenses. They would amount to at least £3 10s. per week, and if in addition there were a power-driven saw or other machine installed, decidedly more—probably about £4 per week. Of the above items, the cost of "non-chargeable time" will be one of the heaviest and the least often considered.

This £4 per week has to be spread over the chargeable working hours, *i.e.*, those for which the owner and his assistant are being paid by the customer for work done. In this connection, if the assistant is not a skilled hand, his time should not strictly speaking bear as full a proportion of the overhead cost as the employer's; he may be in fact partly an overhead charge himself. We may assume, however, that the owner and his assistant work 80 chargeable hours per week between them. Overhead charges are therefore 1s. per workman hour and rates

of earnings being commonly below those obtaining in urban industry, this may very likely represent 100 per cent. on labour.

We can safely say that, owing to mass-production methods and labour-saving devices, a manufacturing job occupying 100 workman hours in the factory, requires 200 in the country shop without machinery. As we are supposing, however, that the latter has a power-saw, we will reduce this to 170.

Let us now compare these estimates :—

Factory.	£ s. d.	*Country Shop.*	£ s. d.
100 Hrs.—labour at average cost of 1s. 6d., say ...	7 10 0	170 Hrs. labour at average cost of 1s.	8 10 0
100 Hrs. on costs at 2s. ...	10 0 0	170 Hrs. on cost at 1s. ...	8 10 0
	£17 10 0		£17 0 0

In this hypothetical case, which we can imagine represents the cost of production of, say, a farm cart, the country shop has a few shillings advantage over the factory, an advantage, by the way, due rather to lower wages than to lower costs. This sum has to be used to offset the larger manufacturers' advantage in wholesale buying of materials, to provide any margin for price competition, and also for the larger profit per vehicle required by the small man. The margin is obviously totally inadequate for underselling the factory.

The position outlined above can be improved within limits if there is sufficient work going to warrant the employment of more workers to spread the charges over. Overhead costs, however, have an unpleasant habit of increasing rather rapidly in a small business. For instance, in this case two more workers would apparently double its size, but the owner himself would become more of a supervisor and less of a producer, and a larger proportion of the cost of his time would become an overhead charge. Employees demand higher wages than the working owner often expects to earn himself, and it is clear that additional assistance, if it is to bear its proper share in reducing these costs, must be of the skilled productive order. To engage extra labourers or boys would merely add to them.

It is easy to account for the prevalence of a too favourable view as to the overhead charges of a country shop. It results from confusing the conditions which govern repair work with those of manufacture. There are seldom any mass-production ways of doing repairs, and the country wheelwright in this branch can compete very nearly on level terms as to working time and methods of doing the job. The factory may perhaps

have spare parts available, but this is no overwhelming advantage, and spares are usually charged for at a good deal higher rate than when they form components of a complete new article. In repair work, therefore, it is quite right to assume that his lower costs of working will give him a decided pull over the bigger business, but to apply the same reasoning to the production of new goods for sale is altogether wrong.

Importance of Proper Costing.—The undercutting done by some small businesses, to which we have referred above, is due not so much to low costs as to the fact that no proper accounts and costs records are kept. A system of book-keeping and costing, however simple, is essential. Without it, it is impossible to manage a business efficiently, or to compete intelligently with others. The lack of it is the cause of most financial disasters.

Note.—Two pamphlets issued by the Bureau deal with book-keeping and costings in a simple and elementary form, designed specially to meet the needs of the small business. The wheelwright is advised to study them and use the methods recommended to ascertain in his own case how he stands on different jobs, and whether the prices which he gets return him actually a profit or a loss.

The Quality of the Vehicle.—Another point often put forward is that the country wheelwrighting shops can and do turn out vehicles superior to the factory product. If this were so, one would not have expected them to have lost the farmer's custom to so large an extent as they appear to have done, as they are admittedly prepared to cut prices to a sufficiently fine degree. As a matter of fact, though there are exceptions, it is nowadays far from being generally or even usually true; one of the most important parts, if not the most important, of the cart or wagon, and that on which the greatest care and skill used to be expended, was the wheel, and it is common to find that the country worker nowadays buys his wheels ready made from the factory. It is true, however, that the class of vehicle produced in the country shops a generation or two ago was better value for money than the factory made article is to-day.

Repair Work and Side-Lines.—So far we have considered the country wheelwright solely as a maker of farm vehicles of various types, but it is quite common to find him more or less of a general purpose village woodworker as well.

Even in its palmy days the wheelwright's business by no means always concerned itself exclusively with building and repairing agricultural vehicles. It was frequently, also, the general local woodworking shop, just as the smithy, apart from farriery, was the local shop for work in iron. Of late years,

owing to the decay of vehicle building, many of the men have had to develop other lines of activity to a much greater extent than formerly. In some parts of the country, there are even now special lines of work reckoned to belong to the wheelwright, such as coffin making, hurdle making, etc., while it is fairly general to find at any rate the smaller businesses regularly turning to fencing, repairs to gates and farm buildings, and all the general jobbing work embraced in the term estate carpentry. Others again, where the opportunity presents itself, have turned in the direction of the building trade and taken up house carpentry and joinery, as a more remunerative occupation.

These developments may be considered retrograde, in the sense that such work is less skilled than the manufacture of wagons. Although repair work may pay better for a time, the capacity to repair will be lost in the end by those who have no experience in building the vehicles themselves, with the result that the loss of the repair work itself may be finally anticipated. But the changes are inevitable here and there, especially in the case of a business on a very small scale where the owner's financial resources and credit are too low to tide him over periods of depression, or to enable him to adopt the suggestion made above as to making a few vehicles for stock. Such a man should study still more than he has done in the past, the newer needs and possibilities of his own neighbourhood outside his specialised craft and try in all possible ways to adapt himself to them. At the same time, it is to be expected that this process, the stages in which are alluded to above, will lead in the next generation to the complete submergence of the wheelwright into the jobbing carpenter.

In regard to side-lines, several of the Bureau's publications dealing with woodworking trades, may provide useful ideas suited to individual cases. Particulars can be obtained on application to the Bureau, 258-262, Westminster Bridge Road, London, S.E.1.

Machinery.—The question as to whether it is advisable to instal power-driven woodworking machinery is important, and in these days it is certain that for the would-be cart and wagon builder to do without it altogether, is in nine cases out of ten a great mistake. It requires, however, careful consideration on the part of the individual concerned. A great many country shops, perhaps the majority, make no use of it, some because they cannot afford it, some because the amount of work ob-

tained would not in their opinion warrant it, others again, from mere disinclination to new-fangled ideas. In a small country business the amount of machinery put in can very easily be overdone, and the potential output of the shop increased beyond the local requirements. Generally speaking, however, the small man will find that the possession of some up-to-date labour-saving device has a beneficial effect not only on his business, but on his outlook and methods out of all proportion to the actual amount of time it saves. It enables him to undertake jobs he never thought of doing before, and intelligently used and exploited, it helps to stimulate and educate the local demand for his services.

Wheelwrights who also carry on a blacksmithing business might find information of interest and value in the Bureau's pamphlet No. 4, and would be particularly advised to consider whether it would not be of value to use acetylene welding apparatus. More than one country worker in this category has stated that its installation has been very helpful to him and brought a large volume of extra work, so that he could not now possibly do without it.

The Necessity of Organisation.—A yet more important and pressing matter than new branches of work, new methods of business and modern equipment or machinery, is a new policy of organisation, combination and education. The country craftsman needs to take an interest in the welfare of the industry at large, to keep less aloof from others engaged in it, to regard them less as enemies to be undercut if possible and more as potential colleagues available for mutual help and protection. Very few seem to be members of any Trade Association and the majority are apt rather too readily to assume that such associations exist to advance the interests of urban industry to their own detriment. But the attitude of mutual distrust among village tradesmen is helping to ruin their trade and must be dropped.

There is already in existence an Association of Vehicle Builders, and in this organisation there should be found a body which could, if its membership included an influential proportion of country wheelwrights, do much to remove the apprehension that the next generation will see the small men largely swept out of existence. Unless some action along these lines is taken, the fear is but too likely to prove well grounded.

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THE NATIONAL POULTRY INSTITUTE.

THE following statement was made by Mr. P. A. Francis, the Ministry's Poultry Commissioner, at a meeting of the National Poultry Parliament at Salisbury, on Wednesday, 16th July, 1924:—

All the arrangements for commencing work in five of the six sections provided for under the National Poultry Institute Scheme are now completed. It will be remembered that the original scheme, the general plan of which has not been altered, aimed at the provision of centres as follows:—(1) a new centre for higher instruction and commercial experiments in poultry husbandry, to be located at Harper Adams Agricultural College, Newport, Salop; (2) scientific research in problems of poultry breeding, at the School of Agriculture, Cambridge; (3) scientific research in problems of poultry nutrition, at the School of Agriculture, Cambridge; (4) scientific research in poultry diseases, at the Ministry's Veterinary Laboratory; (5) practical experiments in the North of England in the breeding of poultry for egg production, and (6) practical breeding experiments in the South of England in table poultry production. Active work is now proceeding in all these sections except the proposed new educational centre at Harper Adams College.

As regards the Harper Adams College part of the scheme, the first step will be to secure the services of a Director possessing the requisite technical and academic qualifications and experience to take charge of the work under the Principal of the College. The Governors of the College have been authorised to invite applications for this post, and it is understood that, in response to announcements widely advertised in the poultry press and elsewhere, a considerable number of applications have been received. These are now being considered by the Governors, who will be responsible for making the actual appointment, subject to confirmation by the Ministry after consulting the National Poultry Institute Advisory Committee. As soon as practicable after the new Director has taken up his duties, detailed proposals, with estimates, will be drawn up for the commencement of work under this part of the Scheme.

Breeding Research.—The new buildings for research in problems of breeding (*i.e.*, a laboratory and cottage) are now completed, except that the laboratory has not yet been equipped with the necessary fittings. A beginning has, however, been made with the actual breeding investigations, a programme having

been drawn up for a series of experiments designed to throw light upon the inheritance of fecundity, which is regarded as the main line of investigation. From the very nature of the work, at least two and a half years more must elapse before even a preliminary report can be framed, for even this cannot be done without the evidence afforded by three successive generations of birds.

Nutrition Research.—As regards research work in problems of poultry nutrition, the necessary poultry buildings, etc., have been erected at Cambridge and are now being used. The following is an outline of the programme of research at present being carried out:—

Partition of Nitrogen of Urinary and Fæcal Origin.—Dr. E. H. Woodman has already evolved a satisfactory method for the quantitative estimation of uric acid in poultry excreta. It is hoped that information will be obtained from this method which will enable the investigators to invoke the chemical method of separation of the urinary and fæcal nitrogenous constituents from the excreta of normal birds. The methods already in use are not considered reliable.

Digestibility.—Digestibility determinations of Sussex ground oats and maize meal have been undertaken with four White Leghorn cockerels. Complete results will not be available until the matter referred to in the preceding paragraph has been settled. Preliminary figures so far obtained show close approximation to Kaupp's and Ivey's digestibility co-efficients, and indicate that the digestibility of the fibre of oats is little affected by grinding.

Future Digestibility Determinations.—In the immediate future it is intended to determine the digestibility of (1) the oats from which the Sussex ground oats already used for experiments were made, (2) the maize from which the maize meal already used for experiments was made, and (3) two strong wheats (Yeoman and Durum) and two weak wheats (Swedish Iron and Rivett). The determination of the digestibility values of weak and strong wheats is considered to be of immediate economic importance.

Mineral Balance Experiments.—An attempt has been made to ascertain the calcium, sulphur, nitrogen, phosphorus and energy balance of pullets before and during egg laying. Two White Leghorn pullets have been used for this experiment, and the material necessary for the determination of these balances has been collected over a period of 14 weeks. The analytical

work involved is heavy, and several months must elapse before the results can be collated.

Comparative Slaughter Experiment.—200 White Leghorn eggs have been incubated to form material for slaughter and analysis at different ages from the egg to maturity. Samples have already been prepared and bottled for analysis as follows: (1) new laid eggs, (2) 14th day incubation, (3) "pipping" stage of hatching, (4) 7-day-old chicks, (5) 3-weeks-old chicks. Further material will be collected at intervals of one month.

Method of Absorption of Yolk Sac Material.—100 White Leghorn eggs have been incubated in order to trace as far as possible the nature of the changes undergone by the yolk sac and its contents from the 10th day of incubation onwards, and its relationship to the alimentary canal. The following facts have been elicited. (1) At no time is there any tubular connection between the yolk sac and the interior of the gut. (2) The intestines, which lie outside the body in the earlier stages of incubation, are drawn into the body on the 19th day and not on the 15th as stated by some scientists. (3) The yolk sac is drawn into the body cavity during the 20th day of incubation.

Disease Research.—The new buildings and equipment for research work in poultry diseases at the Ministry's Veterinary Laboratory have been completed and are now ready for use. Actual research work in connection with poultry diseases has been carried on in the main laboratory for over two years, and a very large amount of post-mortem work has also been done for poultry owners. Some of the diseases on which research work has been begun are: Fowl Cholera, Fowl Typhoid, Bacillary White Diarrhœa, Fowl Plague, Tuberculosis, Avian Diphtheria, Bird Pox, Coccidiosis and Blackhead.

The progress of the research work has recently been delayed owing to the officer who was primarily in charge of it having left to take up another appointment elsewhere. The services of a suitable officer to take his place have, however, been obtained, and the work will now proceed on methodical lines.

Northern Breeding Experiments.—A special Sub-Committee of the National Poultry Institute Advisory Committee has been appointed to deal with the Northern Experiments in breeding poultry for egg production. It is at present constituted as follows: Professor S. J. Hickson, D.Sc., F.R.S., Chairman (nominated by the Ministry); Messrs. J. Edmondson, W. Sutton, J. Wrennall, C. Longbottom, G. R. Poole (nominated by the National Poultry Council); Principal W. B. Mercer, of the Rease-

heath School of Agriculture (nominated by the Ministry); Messrs. F. Snowden and D. C. Hesketh (co-opted by the Sub-Committee); and Mr. W. Thompson (nominated by the National Poultry Council in place of Mr. Hammett, appointed a member of the Main Committee); with Mr. F. Glover, of the Ministry, as Secretary.

The Sub-Committee held its first meeting on 4th September last, and at once proceeded to draw up its scheme of experiments, which is as follows:—

(1) To test experimentally the effect of inbreeding with certain selected strains of fowls, by mating together brother and sister, dam and son, sire and daughter, dam and grandson, etc., the relative fecundity of the matings to be carefully recorded.

(2) To test the effect of out-breeding on fecundity in certain selected strains of fowls.

(3) Concurrently with (1) and (2), to make observations on the strains employed in order to obtain evidence on the question whether there is, or is not, a linkage between external characters and fecundity.

(4) Concurrently with (1) and (2) to record any data bearing on the possibility of building up a strain of pullet breeders.

The Sub-Committee sent its scheme of experiments to the County Councils of Lancashire and Cheshire with a suggestion that facilities for the experiments might be provided either at the Lancashire County Farm at Hutton, or at the Cheshire School of Agriculture, Reaseheath. Both Councils offered facilities readily on certain conditions, and after consideration the Sub-Committee recommended that the offer of the Cheshire County Council should be accepted. A very suitable site at Reaseheath, on old turf over well-drained soil, easily accessible from a main road, was accordingly secured.

The Sub-Committee, after this, got very quickly to work in making arrangements for the provision of the necessary accommodation and equipment for their experiments, and by 31st March last, practically all the plant and appliances required were on the site and ready for use.

The majority of the female stock required for the experiments was purchased at the auction sales held at the Egg Laying Trials in Lancashire in November, 1923. These included good layers as well as bad layers, of the following breeds: White Wyandotte, White Leghorn, Rhode Island Red. The initial stock were mated during the third week in March, and the poultryman to conduct the experiments was engaged to take up his duties on 1st April last.

Southern Breeding Experiments.—The Sub-Committee which is dealing with the Southern Breeding Experiments in the production of table poultry held its first meeting on 25th September, 1923, and is at present constituted as follows: Principal R. M. Wilson, B.Sc., Chairman (nominated by the Ministry); Messrs. Harold Corrie, J. H. Dowden, A. P. F. Grant and the Revd. H. Mayall (nominated by the National Poultry Council); Mr. Thomas Neame, co-opted by the Sub-Committee in place of Dr. J. L. Rosedale (resigned); Mr. Nelson Kenward (nominated by the Ministry); Mr. A. S. Juniper, co-opted; and P. Hedworth Foulkes, B.Sc. (nominated by the Main Committee); with Mr. C. T. Stock, of the Ministry, as Secretary.

A site for the experiments has been generously provided by the Governors of Wye College and is situated on the College Farm, a water supply having been specially laid on to the site free of charge.

The Sub-Committee has decided to begin its work with experiments on the following lines:—

(1) To ascertain the amount of weight and value of weight gained by various breeds and cross-breeds of poultry in relation to the weight and value of food consumed; also the feeding costs of finished fowls for the table and the best breeds or cross-breeds to use for this purpose.

(2) To ascertain the most profitable methods of feeding and marketing birds produced as a by-product on commercial egg farms.

(3) To ascertain the value for table purposes of the breeds most generally used by commercial egg farmers, as compared with the breeds and cross-breeds usually regarded as best for table use; also whether it is likely to be profitable for commercial egg farmers to continue producing chickens for table use, from the birds they usually keep, at times of year other than the usual season for hatching laying fowls, and, if so, what are the best methods of feeding and marketing the birds.

The experiments have been begun with a small number of breeding pens composed of the following breeds and cross-breeds: White Leghorn, White Wyandotte, Rhode Island Red, Light Sussex, Indian Game crossed with Light Sussex, and Silver Gray Dorking crossed with Light Sussex. All suitable eggs laid by these birds will, if practicable, be incubated under hens during the whole of the first year of the experiments, and the resulting chickens will be divided into four lots and marketed as: (*a*) Petit Poussins; (*b*) Chickens off the run; (*c*) Trough-fed chickens; (*d*) Chickens finished by cramming.

All the breeding stock has been purchased with the exception of two Silver Gray Dorking cockerels. Approximately 400 chickens have been hatched and will form the nucleus for the experiments. It has, however, unfortunately been necessary to kill off the Rhode Island Red chicks owing to an outbreak of what appears to be bacillary white diarrhœa. Blood samples are now being taken from the parent birds of these chicks with a view to examination at the Ministry's Veterinary Laboratory.

All the accommodation and equipment for the experiments has been provided and is now in use. A Manager-Recorder and a Poultryman have been appointed and took up their duties on 3rd March last. The Sub-Committee is at present engaged in some test experiments preparatory to a full year's work on the lines indicated above, which it is hoped will commence not later than the beginning of next year.

Note.—Three-fourths of the total capital expenditure in connection with all the work referred to above will be met by the Ministry out of grants from the Development Fund, the remaining one-fourth being contributed by the poultry industry. All the cost of maintenance is being provided for by the Ministry out of Development Fund grants.

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LOANS TO CO-OPERATIVE ENTERPRISES.

The following are the terms and conditions under which loans will be made to Co-operative Enterprises:—

1. The Ministry of Agriculture will make loans to Agricultural Co-operative Societies registered under the Industrial and Provident Societies Acts to the extent of such funds as may be placed at its disposal. In order that a Society may be eligible for a loan the Society must have for its Object such agricultural purpose as may be approved by the Ministry, and its capital must be subscribed mainly by agriculturists. The share capital paid up by the subscribers must not be less than 5s. per £ share and the rate of interest on the paid up share capital must be limited to 5 per cent. In special cases, however, loans may be made to existing Societies whose rules allow a maximum interest of 6 per cent. provided an undertaking is given that while any part of the Government loan is outstanding the actual rate of interest paid on the share capital will not exceed 5 per cent.

2. The amount of the loan from the Ministry will not exceed (*a*) half the total amount considered by the Ministry to be

necessary for the proper equipment and working of the society, or (*b*) the amount of subscribed capital, whichever may be the less. No loan will be granted until the Ministry is satisfied that the remaining capital required for the proper equipment and working of the society will be available. Advances to existing societies will normally be made only for the purpose of improving or extending premises and plant.

3. In no case will the Ministry's loan exceed the sum of £10,000 to any one society.

4. In the case of a newly-formed society the loan will be secured by a first debenture upon all the assets (including uncalled capital) of the society. In the case of an existing society, it will be secured if possible by a first charge on the premises and plant obtained or improved with its assistance. If such a charge cannot be given, the Ministry will require other satisfactory security.

5. Interest will be charged on the loan at 5 per cent. per annum, and the loan will be repayable in instalments spread over a period not exceeding twenty years. Both interest and repayment of principal will be payable half-yearly. The first payment in respect of both interest and principal may be deferred by the Ministry for thirty months after the date when the loan is actually paid over, or, if the loan is made in more than one instalment, thirty months after the date when the first instalment is paid. The first payment to the Ministry will be six months' interest on the whole amount of the loan and one-fortieth of the principal.

No charge will be made on account of interest for the period from the date when the whole loan (or the first instalment as the case may be) is paid over up to a date six months before the first payment to the Ministry falls due.

6. The Ministry must reserve the right to require at any time immediate repayment of the principal of the loan and all outstanding interest, but there would be no intention to exercise this right so long as the Society was managed to the satisfaction of the Ministry. The Ministry will also have the right, if it so desires, to inspect the work of the Society and to be represented at meetings of the Committee of Management of any Society to which a loan is made.

7. The Society shall cause an audit of accounts to be made yearly by an Auditor approved by the Ministry and a copy of the Auditor's report and of the accounts shall be supplied to the Ministry. The books of the Society shall be open to inspection by an officer of the Ministry at any time.

AUGUST ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Weather Notes.—The normal weather of August is very like that of July; the differences are a slightly higher rainfall and a tendency towards lower temperatures. The duration of daylight (about 15 hours a day in August) and of bright sunshine continues to diminish from the maximum enjoyed in June. Normally, conditions are not quite so favourable to the quick and thorough drying of materials—mown grass, weeds in fallows, etc.—as in July; on the other hand the pastures, which seem to make no growth whatever during the seventh month, now begin to freshen again.

The beginning of August has often been a wet period, hence the term Lammas flood; but it sometimes happens that dry weather prevails during the early part of the month and a wet spell sets in about the time the crops in the midland and northern counties are ready for cutting. One of the most memorable harvests, characterised by weather of the latter kind, was that of 1918; in that year crops were well secured south of the Trent, but farther north the three-fold misfortune of lodged crops, shed grain and sprouted stooks was widespread.

Corn Harvest.—In the Midlands the usual order and typical dates for the commencement of cutting the cereals are as follows: winter oats, 3rd August; spring oats, 12th; wheat, 15th; and barley, 20th. Seasons vary greatly, however, as may be illustrated by reference to the fact that, whereas wheat-harvest began during the last week of July in 1921, this crop was not ready for cutting until the third week of August in the following year. As regards this year's harvest, present indications are that it will be rather late.

In mediæval times, Lammas—1st August—was celebrated by the offering of loaves baked from the flour of that year's crop; indeed, the word Lammas is derived from the Anglo-Saxon "Hlaf-mass" or Loaf-mass. The apparent earliness of the Old English harvest must, however, be discounted by the fact that in A.D. 1582 the calendar was altered, so that the Lammas of those days corresponds to 12th August in the modern calendar.

Ripening of Corn.—Cereals ripen continuously, but four successive stages may be recognised. The time required in passing from one stage or condition to the next depends on the season, the soil and, to some extent, the variety of the crop. In a hot dry August, corn may quickly pass from the green to the dead-ripe white condition, especially on sandy or shallow soils, whereas under the opposite conditions the grain may remain soft and waxy for an indefinite period. The four stages of ripeness are :—

1. *Milk-ripe.*—The entire plant, including the seed-skin, is green, and the "seed" or "berry" is full of a milk-like fluid. Usually the crop remains in this condition for about 5 weeks after flowering.
2. *Yellow-ripe.*—The plant, including the seed-skin, is yellow, only the knots in the stem remaining green. The seed has become waxy in texture; when pressed between the finger-nail and the thumb, it breaks but does not quash or exude milky fluid. Typically the crop passes from yellow to full ripeness in about a week.
3. *Full-ripe.*—The tinge of green has gone from the straw just below the ear and the seed does not now break but only bends on the finger-nail; but it also "sheds" more readily.
4. *Dead-ripe.*—The straw has become white and the knots have dried and shrivelled; the grain readily sheds, and, if the weather has been good, the seed is now hard and brittle.

In times when the loaf was made entirely of home-grown wheat, early cutting was advocated in the belief that grain so harvested yielded a stronger flour. It is now known that "strength" is chiefly a matter of the variety grown; and further, that if the crop is cut before attaining the yellow-ripe stage, it cannot fully complete the filling of its seed. Although there is little increase in the total weight of corn and straw after the crop has reached the milk-ripe stage, the transfer of food material from the leaves and stem to the grain continues for as long as the crop contains green colouring matter; and, as moisture is the vehicle, the stem must remain connected with the roots in the soil, until the green colour has entirely disappeared; this indicates that the process of food-transference is at an end. Failure of the soil-moisture supply or the lodging of the crop produces effects similar to those attributable to premature cutting, viz., a reduced yield and a high proportion of improperly filled grains.

Barley intended for malting is allowed to become dead-ripe—the ears bending over—to ensure unison in the germination of the sample and to allow of stacking with the least exposure and discoloration of the crop in stooks after cutting. Seed-corn of other cereals is likewise allowed to ripen to the third or fourth stage, chiefly because—as with malting barley—after full-ripening it germinates with greater unison. Corn cut somewhat early produces an irregular plant, unless the seed has been previously stored dry for some months. Obviously, therefore, complete ripening is more necessary in the case of seed intended to be sown in the ensuing autumn than it is for spring cereals.

With cereals other than malting-barley and autumn seed-corn, cutting may begin as soon after the yellow-ripe stage has been reached as weather conditions permit. Perfectly regular ripening is, however, rarely seen in practice, thin crops especially often having late tillers: waiting for these may involve shedding of the top corn of the earlier shoots and perhaps incur a waste of good weather. Where the labour supply is short, and generally when good-ripening weather prevails, cutting should begin rather on the early side. In unfavourable weather, ordinary crops take least harm while uncut; rank crops, likely to lodge, however, are an exception to this rule.

Self-Binders.—The operation of a self-binder affords opportunity for the exercise of mechanical instincts, to prevent or correct the various troubles that occasion costly delays in the harvest field. Into the details of that subject it is not intended to enter; but mention may well be made of the fact that one of the common troubles—the machine throwing out sheaves with untied or broken bands—is often attributable to the neglect of simple details, such as omitting to sharpen the twine-knife or to grease it to prevent its rusting, and attempting to tighten the sheaf by increasing the tension on the twine between the can and the needle.

The machine makes straight-butted sheaves only when the cut grain is correctly delivered to the sheaf-making mechanism: the heads and the butts must arrive at the binding deck simultaneously. If either the heads or the butts come down first, the resulting sheaf will have an oblique base. To ensure the cut grain being correctly delivered to the sheafing-apparatus, the slope of the platform must be adjusted, so that the arrival of the heads on the first canvas is either delayed or hastened as may be required; and the reel must be so operated as to increase the effect of the adjustment of the slope of the platform.

The size and tightness of the sheaf must vary according to the condition of the crop, the date of cutting, the climate, and the absence or presence of green material in the butts. Under good and early conditions, sheaves weighing when dry about 10 lb. are about the right size; but in late and moist districts, half that weight may be recommended, in spite of the greater expense incurred by the larger twine consumption. In an ordinary four-quarters crop of wheat, a 6 ft. machine drops a sheaf every 4½ yards, when set to make sheaves that weigh 10 lb. at stacking time; in this case there are 550 sheaves per acre.

Stubble Cultivations.—It may often be observed that the land is rather soft when the reapers are at work; but, by the time the crop has been housed, the soil has become so hard-baked as to be unworkable with horse-drawn implements. The shade of the crop, especially that of a dense crop, keeps the soil-surface in a tilth; but this soon disappears under the influence of drying weather, after the crop has been cut. For this reason, immediate attention to the stubbles may greatly expedite later workings. Metaphorically, the skimming plough should be hitched behind the reaper: in practice, stubble working may begin as soon as the corn is in stook.

A dry autumn enables considerable progress to be made with the eradication of weeds of the couch or twitch type, if the soil can be stirred before it has hardened. The stubble should be ploughed about three inches deep, to lift the weedy layer; and this may with advantage be drawn up in small ridges, after the fashion of the work of the Kent broadshare. In due course the weeds are worked out, dried and collected. Unfortunately, the eradication of such pests by working-out and collection can rarely be made a complete success; nearly always sufficient is left in the land to start another "crop" of the weed.

As regards some of the most troublesome annual weeds, such as charlock and poppy, shallow working of the stubbles (with a view to inducing the germination of the seeds shed from this season's growth) yields disappointing results. The seeds of these two weeds appear to require a resting period, as only a very small percentage of the new seed will germinate in time to be destroyed by later autumn workings or by the winter weather. Deep ploughing, on the other hand, does not destroy the weed-seeds: when so buried they remain alive for years, and germinate when brought up again during the workings for some future crop. Where it is possible to give charlock-infested land

an autumn cleaning, the ploughing should be deep enough to bring up seeds that have been lying dormant during the past season. The seed of spurrey, a very troublesome weed on light, sour soils, does germinate in the autumn of the year in which it is produced; hence in this case the formation of a shallow surface tilth (such as would be made if attempting to secure a catch crop of crimson clover) is a valuable aid to the reduction of this pest.

Wheat after "Seeds" and Bare Fallow.—It has long been a rule of good husbandry to plough "seeds" stubbles early when intending to follow with wheat. Early ploughing ensures more complete decay of the stubble and root residues and averts the danger of a "root-fallen" plant. Under dry conditions, also, early ploughing is desirable to prevent the land being dried out too deeply by the growth of aftermath. A third reason for early ploughing applies particularly to grassy leas, but not to pure clovers, viz., that it protects the wheat crop against frit fly attack: this matter is explained in the Ministry's Leaflet No. 202 (*The Frit Fly*). On the other hand, early ploughing may attract the Wheat Bulb Fly, which lays its eggs on bare soil in the summer—*see* Leaflet No. 7. The injury done by each of these pests is often wrongly ascribed to wireworm, to bad weather and to other causes. Every case of loss of wheat plant in the winter should, therefore, be reported for investigation by the Entomologist attached to the provincial agricultural college.

White Winter Oats.—The writer would appreciate reports of experiences with white winters during the past season, particularly with a view to ascertaining the effect of date of drilling and degree of consolidation of the land before sowing. Reports of cases where blacks or greys were sown at the same time, etc., as whites would be of special value. Address:—County Education Office, Derby.

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NOTES ON POULTRY KEEPING.

C. A. FLATT,

Ministry of Agriculture and Fisheries.

Management of Cockerels and Pullets.—Chicken rearing troubles are practically over and the young birds growing apace. On the farm, following hay harvest, with the Sussex arks out in the fields, the young cockerels come on so rapidly that every week of fresh "draft" is under orders for the fattening crates.

Although there is an abundance of natural food for them, it pays to provide a generous supply of cereal food at this stage in their growth, in the form of wet mash or boiled wheat, for the birds destined for market. A bird in good condition will make a better finish in the fattening crate than the lean specimen with all its weight in the frame. There is a period, too, when table condition is hard to keep, and at this season it is not economical to retain cockerels, other than those intended for breeding stock, over this period. This applies not only to poultry keepers with limited land accommodation but to farmers, where the provision for housing the poultry is so frequently inadequate.

A fowl weighing 4-4½ lb. is in general demand; larger than this it is seldom worth while to produce at seasons other than Christmas and later hatches will provide Christmas birds.

The pullets also make rapid development, with everything in their favour for growth. Often, this is too rapid, and it is a mistake to run cockerels and pullets together and so hasten maturity. A pullet that commences to lay at 4½-5 months of age seldom makes the required growth, the eggs are small and frequently fail to attain the necessary standard at a later stage.

While it is always a problem to check the early pullets from laying prematurely, there is no doubt that the diet is too stimulating in many cases, and the use of all animal food might well be dropped while there is insect food in abundance. A broader ration with cereal foods, largely grain, will produce the incentive to the birds to forage and develop more naturally.

It was a matter for surprise when handling many of the pullets on arrival at a leading laying test last season, to find so large a percentage without an ounce of surplus fat on their bodies. There should be some surplus at the commencement of a strenuous period of egg-laying, and the diet of a growing pullet can with advantage be broader than that of the laying bird, in order to make this provision.

Stubbles on the Farm.—From present appearances, the harvest will be well under way by the time these notes appear, at least in the south, and in all probability a good deal of corn spilled from the ear will be lying on the ground. Here the poultry flocks come in again to assist the profit on the farm.

There is nothing so handy as the Sussex night ark as shelter for the birds on the stubbles. Well-ventilated and consequently suitable to accommodate a number of young birds, they are light and easy to cart from one field to another as the corn is cut.

Turkeys and geese can be driven out to the fields to glean and brought back in the evening, if necessary, but it would frequently be more expedient to put up rough shelters in the corners of the fields. But for the danger from foxes, and in some parts from theft, no provision would be required for the turkeys in the open other than perches.

Turkey Rearing.—The annual crop of turkey rearing troubles has arisen. Absence of ventilation in night shelters is a fruitful cause of trouble. The young birds are left with the ordinary hen until they are taller than she is. This is a good plan, as turkeys are notoriously silly things, even for poultry, and the hen provides useful guidance and some protection, but it is a fatal mistake to leave them too long in the coop, even when this is a large turkey coop. The young birds want space and air at night, but the coops, when shut up, get hot and stuffy, especially with the early morning sun, and when let out the birds are liable to chill on top of the evil of vitiated air during the night.

It is not easy to regulate conditions, and turkey rearing needs careful attention. The hot days and cold nights following, in a draughty house, may cause loss, but even this is less fatal than stuffy conditions. Plenty of air is necessary, and proper ventilation eliminates draughts.

Turkey rearing on any large scale cannot be recommended without plenty of space for the birds to roam and to feed naturally. Turkeys require a lot of green food, are at the best dainty feeders, and the absence of fresh green food and an excess of starchy foods will bring troubles.

The birds do well when roaming the stubbles. Fresh land is a boon in turkey rearing and will do much to tide over the dangers of "Blackhead." Of cures for this disease in turkeys very little is known, as of turkey ailments in general, and it is probable that many cases are wrongly diagnosed as "Blackhead" where losses occur from symptoms which are similar. The individual doctoring of a turkey is a thankless task, and upon the appearance of illness in a flock, isolation of any sick birds and removal of the healthy birds to fresh ground, with careful disinfection of houses, drinking vessels, etc., is a wise precaution to be taken speedily. It is well to restrict the area of the fresh ground at first, in order to limit the possibilities of further infection of the land.

Some of the early losses are occasioned by lice, which are often not detected until the bird is thoroughly infested, by

which time it may have suffered past recovery. The hen used for rearing should be clean and healthy, a point often overlooked.

Treatment for Laying Hens.—Many of the older laying hens will be cleared out at Michaelmas, or a little later. These are just the type of stock for "stubbling" after the later harvests. It is a season when the pullets intended for autumn production need to be settled in their permanent quarters and, if they are on the stubbles too late, removal after they have begun to lay is likely to cause a check and a moult amongst some which is liable to spread through the flock. The hens which in any case cannot be depended upon for production in the scarcer season will often produce heavily through September with a change of ground and abundant food on the stubbles, and, if not left too long, when the shed grain is cleared and food becomes harder to secure they can be taken up and sold while still in good condition.

Blackberry Chickens.—It is questionable whether late summer hatching is worth the while of the poultry farmer, whose accommodation and labour is usually better employed in the production of winter eggs. But upon the general farm "blackberry" chickens are very profitable. The breeding stock is generally still in good condition and, with the use of hens for hatching and rearing, the chicks are little trouble in their earlier stages. With good poultry management on the farm, before the end of October the earlier pullets are in their winter laying quarters, and the hens are reduced by culling to a minimum, consisting of those required for the following season's breeding and the others worthy of retention for egg production. The smaller houses or arks used for rearing will then be available for these late-hatched chicks and, although growth at this season is less rapid, feeding on the farm is less costly. The young birds do well in the shelter of the corn stacks, where they always pick up a certain amount of their own living and, after thrashing, turn the spilled grain to good account. Sold at Christmas and in the two succeeding months, when poultry is always scarce, they make very good prices.

The farmer who does not wish to invest capital in laying houses is far better advised to sell his pullets, for which there is a great demand in the autumn, at lucrative prices, than to keep them in small houses with inadequate shelter, frequently overcrowded, and to use the small houses, as previously indicated, for batches of late chickens.

MONTHLY NOTES ON FEEDING STUFFS.

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The Use of Green Food for Fattening Pigs.—In a recent number* of the Journal of the Irish Department of Agriculture appears a paper by E. J. Sheehy summarising the results of experiments on pigs carried out at Ballyhaise, Athenry and Clonakilty. These experiments, which were commenced in 1922, were designed to test the possibility of replacing separated milk and meals in a pig's dietary by green food, to ascertain the economic extent of such replacement, and to discover whether the value of a ration was enhanced by the addition of green food.

Crowther,† in this country, had already shown that, with growing pigs, no advantage in the rate of growth was obtained by adding a small allowance of green food to a ration consisting largely of cereal products and fish meal. This conclusion was subsequently confirmed by White and Roberts.‡ In the Ballyhaise trials, the green food fed was rape or vetches and oats; in the Athenry trials, green oats, vetches, cabbage and turnip tops; and at Clonakilty green rape. As the result of these experiments, the following conclusions were arrived at:—

(1) Cereal meals or separated milk may be partially replaced by green food, but the extent to which this may be done is strictly limited by the inability of the pig to deal with large quantities of bulky fodder.

(2) The extent of the replacement possible is, for a fattening pig, represented by 6 lb. of green food per day; this, according to these trials, represents 3 pints of separated milk or $\frac{3}{8}$ lb. of meal.

(3) In the case of the lots fed on rape, a bacon-curing test was carried out, and the report indicated that the feeding of green rape led to the production of inferior bacon. It does not necessarily follow that other green foods would have a similar deleterious effect, but the possibility of such an adverse effect following the feeding of green food to bacon pigs should be borne in mind by pig feeders. In any case, it would be desirable to discontinue feeding green food during the last month of fattening.

* Journal of the Ministry of Agriculture and Technical Instruction, Dublin, Vol. XXIV, No. 1, May, 1924.

† Bulletin No. 3, Olympia Agric. Co.

‡ This *Journal*, Vol. XXX, p. 27.

Description.	Price per Qr.		Price per Cwt.	Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	—	—	12/3	12 5	0 15	11 10	71·6	3/3	1·74
Barley, Argentine	36/–	400	10/1	10 2	0 12	9 10	71	2/8	1·43
„ Karachi	35/–	„	9/10	9 17	0 12	9 5	71	2/7	1·38
„ Persian	32/3	„	9/–	9 0	0 12	8 8	71	2/4	1·25
Oats, English, White	—	—	10/4	10 7	0 13	9 14	59·5	3/3	1·74
„ „ Black and Grey	—	—	9/6	9 10*	0 13	8 17	59·5	3/0	1·61
„ Canadian :—									
No. 2 Western	27/–	320	9/5	9 8	0 13	8 5	59·5	2/11	1·56
No. 3 „	26/–	„	9/1	9 2	0 13	8 9	59·5	2/10	1·52
Feed	25/–	„	8/9	8 15	0 13	8 2	59·5	2/9	1·47
„ American	22/–	„	7/8	7 13†	0 13	7 0	59·5	2/4	1·25
„ Argentine	23/–	„	8/1	8 2	0 13	7 9	59·5	2/6	1·34
„ Chilian	22/–	„	7/8	7 13†	0 13	7 0	59·5	2/4	1·25
Maize, American	40/6	480	9/5	9 8†	0 13	8 15	81	2/2	1·16
„ Argentine	38/–	„	8/10	8 17	0 13	8 4	81	2/0	1·07
Beans, Rangoon	—	—	10/1	10 2†	1 11	8 11	67	2/7	1·38
Peas, Japanese	—	—	21/9	21 15†	1 7	20 8	69	5/11	3·17
Millers' Offals :—									
Bran, British	—	—	—	6 10	1 6	5 4	45	2/4	1·25
„ Broad	—	—	—	7 5	1 6	5 19	45	2/8	1·43
Middlings—									
Fine, Imported	—	—	—	9 12	1 1	8 11	72	2/5	1·29
Coarse, British	—	—	—	9 0	1 1	7 19	64	2/6	1·34
Pollards, Imported	—	—	—	6 17†	1 6	5 11	60	1/10	0·98
Meal, Barley	—	—	—	10 15	0 12	10 3	71	2/10	1·52
„ Maize	—	—	—	11 0	0 13	10 7	81	2/7	1·38
„ „ Germ	—	—	—	8 12	0 18	7 14	85·3	1/10	0·98
„ „ Gluten Feed	—	—	—	8 15	1 6	7 9	75·6	2/0	1·07
„ Locust Bean	—	—	—	8 5	0 9	7 16	71·4	2/2	1·16
„ Bean	—	—	—	13 0	1 11	11 9	67	3/5	1·83
„ Fish	—	—	—	18 10	4 3	14 7	53	5/5	2·90
Linseed	—	—	—	20 11	1 10	19 1	119	3/2	1·70
„ Cake, English 12°/₀ Oil	—	—	—	12 12	1 17	10 15	74	2/11	1·56
„ „ 10°/₀ Oil	—	—	—	12 2	1 17	10 5	74	2/9	1·47
„ „ 9°/₀ Oil	—	—	—	11 17	1 17	10 0	74	2/8	1·43
Soya Bean Cake 6°/₀ Oil	—	—	—	11 5*	2 12	8 13	69	2/6	1·34
CottonseedCake,English 5½°/₀ Oil	—	—	—	8 2	1 13	6 9	42	3/1	1·65
„ „ Egyptian 5½°/₀ Oil	—	—	—	7 17	1 13	6 4	42	2/11	1·56
Decorticated Cotton Seed Meal 7% Oil	—	—	—	12 15	2 12	10 3	71	2/10	1·52
Coconut Cake 6°/₀ Oil	—	—	—	9 12	1 9	8 3	73	2/3	1·20
Ground Nut Cake 7°/₀ Oil	—	—	—	9 5*	1 15	7 10	56·8	2/8	1·43
Decorticated Ground Nut Cake 7°/₀ Oil	—	—	—	11 7*	2 13	8 14	73	2/5	1·29
Palm Kernel Cake 6°/₀ Oil	—	—	—	6 17†	1 2	5 15	71·3	1/7	0·85
„ „ Meal 2°/₀ Oil	—	—	—	6 17	1 3	5 14	71·3	1/7	0·85
Feeding Treacle	—	—	—	7 7	0 8	6 19	51	2/9	1·47
Brewers' Grains :—									
Dried Ale	—	—	—	6 17	1 3	5 14	49	2/4	1·25
„ Porter	—	—	—	6 7	1 3	5 4	49	2/1	1·12
Wet Ale	—	—	—	1 1	0 9	0 12	15	–/10	0·45
„ Porter	—	—	—	0 16	0 9	0 7	15	–/6	0·27
Malt Culms	—	—	—	8 0†	1 13	6 7	43	3/-	1·61

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·07	2 0	71·6	7 3	0 15	7 18
Oats	1·07	2 0	59·5	5 19	0 13	6 12
Barley	1·07	2 0	71·0	7 2	0 12	7 14
Potatoes	1·07	2 0	18·0	1 16	0 3	1 19
Swedes	1·07	2 0	7·0	0 14	0 2	0 16
Mangolds	1·07	2 0	6·0	0 12	0 3	0 15
Good Meadow Hay	1·25	2 4	31·0	3 12	0 13	4 5
Good Oat Straw	1·25	2 4	17·0	2 0	0 6	2 6
Good Clover Hay	1·25	2 4	32·0	3 15	1 0	4 15
Vetch and Oat Silage	1·16	2 2	14·0	1 10	0 7	1 17

* * * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending July 16th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	.	13.12	13.12	17. 7
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	12.17*	12.17*	12.17*	12.17*	(N)12. 5
„ „ „ neutral (N. 21.1 per cent.)	14. 0*	14. 0*	14. 0*	14. 0*	(N)13. 3
Kainit (Pot. 12½ per cent.)	...	..	...	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
„ „ (Pot. 20 per cent.)	...	2.10	...	2.17	2.10
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.10	2.15	2. 9
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7.10	3. 0
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.10	2. 0
„ (S.P. 30 per cent.) ...	3.16	3. 7	3. 8§	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8.10	8. 0	...
Steamed Bone Flour (N. ⅞, T.P. 60 per cent.)	6.17†	6.15†	6. 0	6. 2†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ...	...	...	...	13.10	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.
† Delivered (within a limited area) at purchaser's nearest railway station.
‡ F.o.r. Works.
§ Prices include cost of carriage from works to town named.

Ormskirk Potato Trials, 1924.

THE Summer Inspection of the new varieties planted in the Ormskirk trials of the immunity of potatoes from wart disease will take place on Thursday, 14th August. Attendance on this day is by invitation from the National Institute of Agricultural Botany, but the trial grounds are open to all interested in potato growing on the 15th and 16th August. The trials are being carried out at the Potato Testing Station at Lathom, Ormskirk. The Ministry of Agriculture and Fisheries is the responsible authority for the decision and certification as to which varieties are immune from wart disease. The extensive plots of potatoes planted at the station include a large number of varieties from Australia, France, and other foreign countries, and also a considerable number of seedlings from plant breeding institutions, potato raisers and others.

The other trials of the Institute will be open to inspection. They consist of maturity and yield trials of first early potatoes; the Lord Derby Gold Medal Trials, carried out in conjunction with the Ormskirk Potato Society; and a trial of the new wheat Yeoman II, which is being marketed by the Institute this autumn. There is also a large number of demonstration plots of most commercial kinds of immune varieties of potatoes. An inspection of these should be of value to all interested in the potato crop.

* * * * * *

The Cultivation of Figs for Private Use.*

FIGS are grown in pots and boxes, and also in narrow shallow borders $3\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft. deep, composed of good loam and lime rubble made very firm. Brown Turkey is the variety which is mostly favoured. It is a free bearer and a good all-round variety. The trees are planted in borders and trained fan shape to wires 18 in. from the roof glass. When grown in pots they are usually trained to bush shape.

They are started in January with a night temperature of 60 deg. F. rising with sun heat in the day to 80 deg. and should be syringed freely twice daily, morning and afternoon.

When the shoots have made four leaves the point should be pinched out and succeeding growths also pinched at four leaves. When the fruit which has set upon last year's wood is swelling, plenty of water should be given to the roots as well as a light dressing of a good chemical manure, alternated with manure water. As the spring advances the night temperature may be raised to 65 deg. The house should be shut up early

* See *Fig Cultivation*, this *Journal*, March, 1924, p. 1153.

in the day so that the temperature will rise to 90 deg.; the trees should be freely syringed to ensure a moist atmosphere.

The first crop will ripen early in June; a second crop produced on the young wood will ripen in August. In order to produce the brown tint and a fine flavour so much desired, figs require abundance of light.

Red spider is the great enemy of the fig tree, but constant attention to syringing and watering should keep this pest down. In the case of a bad attack the bark should be sponged. During dull, cloudy weather following a spell of hot sunny days, the fruit is liable to split. To avoid this more ventilation must be given, and the afternoon syringing must be stopped, simply damping the floor taking its place for a time.

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Sale of Official Publications in the Royal Botanic Gardens, Kew.

A NEW kiosk has recently been opened at the Royal Botanic Gardens, Kew, for the sale of Guides and other publications relating to the gardens. It is situated at the west end of the Museum of Colonial Timbers, No. 3, near the Main Entrance from Kew Green, and it replaces the former kiosks outside the Main Entrance and at the Victoria Gate. The new Illustrated Guide (published at 1s.) contains thirty photographs and a map of the gardens, as well as descriptive tours indicating to visitors how best they may utilise their time at the gardens.

For students who desire to investigate the treasures of Kew more intimately, the sixpenny Popular Official Guide is recommended, whilst the guides to the various Museums provide handy reference books for one's home library in addition to fulfilling their purpose of indicating the more important articles of economic interest displayed. These guides have been designed to meet the needs of visitors for whom it has been found impracticable, owing to the extent of the gardens, to arrange the services of a guide lecturer as has been done in other public institutions. A new edition has also been published of the Key Plan, on the back of which is printed a list of the principal objects of interest, each with a map reference so that occasional visitors can readily find their way about the gardens. The price of this Key Plan is 3d.

It should be mentioned that a complete new series of 63 postcards illustrating views and principal features of the gardens and specimen trees and plants, has been specially prepared and is now also on sale at the kiosk. They are published in nine sets of seven cards at 6d. a set.

Small Holdings Competitions at the Bath and West Show.

THE judge's report on the competitions for the best managed small holdings held in connection with the Bath and West Society's Meeting at Taunton has recently been issued. There were two classes—one for holdings of from 15 to 50 acres, and one for those from 1 to 15 acres, limited in each case to ex-Service tenants under the Somerset County Council. With regard to Class I, the judge's report refers to the satisfactory standard attained, in particular by the four prize winners, and, while offering some criticisms with regard to some of the other entrants, he stated generally "out of 18 entrants in this class, I was favourably impressed by the standard of farming shown by the large majority of the entrants and likewise by the number and type of stock kept upon the holdings. The cows were, for the most part, of a particularly useful quality."

In the case of the smaller holdings the judge states:—"The outstanding feature in this class is the hard work and enterprise shown by the winners of the three prizes, in converting ordinary farm arable into practically self-supporting market garden holdings, in a comparatively short space of time. Not only does the cropping and general management of the holdings reflect great credit upon the men, but their method of disposing of the produce, in an already crowded market, speaks well for their business capabilities. They are, however, somewhat handicapped by the difficulty in obtaining a sufficient supply of manure at a reasonable cost."

The judge adds that he found the tenants in both classes to be in a contented and optimistic frame of mind, and that they felt confident, if present prices are maintained, of their ability to continue the success which they have already achieved.

* * * * * *

Value of Small Holdings Schemes to Farm Labourers.

An instance of the value of the Statutory Small Holdings Scheme for people of the farm labourer class has been brought to notice in connection with the re-letting of a holding in Lincolnshire. The accepted applicant is an ex-Service man, the son of a farm labourer who was working on the farm in question when it was taken over by the County Council for small holdings 15 years ago. This labourer was placed on a cottage holding comprising 5 acres of very

good land, and has made a great success of it. The ex-Service son has saved £250, and has now been provided with the opportunity to settle down on a 25-acre holding.

* * * * * *

The Bacon Pig.

IN their Interim Report on Meat, Poultry and Eggs, the Linlithgow Committee call attention to the fact that there is a serious disagreement between breeders as to the best type of pig for bacon purposes; they recommend that the Departments of Agriculture should take the lead, and, in collaboration with curers, should make a definite and authoritative pronouncement as to the best type of pig to produce, due allowance being made for variations in local requirements.

In consideration of this recommendation the Ministry recently issued in leaflet form the article on "The Bacon Pig" which appeared in this *Journal* in December last, p. 788. The leaflet deals in outline with the standard which should be aimed at in producing the best type of pig for curing, the best breeds and methods of breeding, and the system of feeding designed to produce the best quality bacon.

Copies of the leaflet have been sent to the various County Agricultural Education Authorities in England and Wales, and to the Agricultural Colleges and Agricultural Departments of Universities and University Colleges, with the suggestion that such opportunities as may present themselves may be taken of encouraging the production of the best type of bacon pigs in this country. The great interest that has been shown by County Education Authorities in the subject is evidence that the matter is regarded as of considerable importance to agriculture at the present time. A copy of the leaflet may be obtained on application to The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

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Proceedings under the Tithe, Copyhold, etc., Acts for 1923.

THE Annual Report of Proceedings under the Tithe, Copyhold, Inclosure, Commons and other Acts for the year 1923 contains the particulars which the Ministry is required annually to furnish of its transactions under the Acts mentioned, and includes, *inter alia*, an estimate of the amount of tithe rentcharge now existing and in the hands of the various classes of titheowners; a summary of the effect of the Tithe Act, 1918, in stimulating

redemption of tithe rentcharge, together with details of the number of redemptions, mergers, altered apportionments, etc., of tithe rentcharge and other similar charges effected under the Tithe Acts, 1836 to 1918; of enfranchisements of copyhold carried out under the Copyhold Act, 1894; and of Regulations and Inclosures of common land and exchanges of land under the various Inclosure and Commons Acts during the year 1923. Tables giving similar information for previous years, which will be found useful for purposes of comparison, are also appended.

The first and longest section of the Report, which deals with transactions under the Tithe Acts, contains, however, in addition to the particulars mentioned, a considerable amount of information relating to tithe rentcharge and similar charges on land which should at the present time when tithe questions are attracting a more than normal degree of public interest, be useful to both owners and payers of tithe rentcharge, especially to such as are contemplating the redemption, merger or altered apportionment of such charges.

An explanation is given in some detail, for example, of the method whereby the compensation for redemption of tithe rentcharge is arrived at under the Tithe Act, 1918, including the provisions of that Act for redemption by annuity and of the effect of rates and land tax paid by the titheowner in respect of tithe rentcharge in the amount of the compensation to be paid on redemptions, whilst figures of the approximate number of years' purchase of the tithe rentcharge to which such compensation has amounted are given for typical average cases during the period under review.

The reasons for the desirability of securing legal altered apportionments through the Ministry in cases where areas charged with one tithe rentcharge have become divided in ownership are indicated, and the effect of informal apportionments of such rentcharge, as to which there is much popular misconception, is explained.

Further sections of the Report of interest are that containing particulars of enfranchisements effected under the Copyhold Act, 1894, as to which there are indications that the number of applications for enfranchisement will probably increase before the provisions of the Law of Property Act, 1922, relating to this subject come into operation, and that dealing with the progress of the Regulation of Commons in the country during 1923, in which connection it is observed that a few very small areas of common land were enclosed for certain public purposes.

The Swiss Fruit Crop.—Not only in this country is the fruit crop this year above the average, but the most recent report of the Swiss crop shows that, according to provisional estimates, there will be an excess of about 16,700 wagons of cider fruit, 7,900 wagons of dessert apples, 10,200 metric tons of plums and 1,400 metric tons of walnuts for exportation. New export markets will have to be found for this surplus fruit.

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Foot-and-Mouth Disease.—It is unfortunately necessary to record an increase in the number of outbreaks of foot-and-mouth disease since the July issue of the *Journal*. In the week ended 29th June, 18 outbreaks occurred (1 each in Berks, Chester, Northants, 3 in Surrey, 4 in Oxford and 8 in Notts); in the week ended 6th July, 20 outbreaks (1 each in Bucks, Surrey, and Warwick, 2 each in Berks and Herts—the latter a new centre, 3 in Northants, 4 in Notts and 6 in Oxford); and in the week ended 13th July, 11 outbreaks (1 each in Berks, Isle of Ely—a new centre, and Northants, 3 in Oxford and 5 in Notts). In the week ended 20th July, 22 outbreaks occurred (9 in Dorset, 1 each in Kent and Worcester, 6 in Oxford and 5 in Notts. The outbreaks in Dorset, Kent and Worcester involved new districts).

The total number of outbreaks from 27th August, 1923, to 20th July, 1924, is 3,198 involving 42 counties in England, 2 in Wales and 12 in Scotland. The numbers of animals slaughtered amount to 106,707 cattle, 45,475 sheep, 49,061 pigs and 129 goats, the gross compensation being £3,401,000 and the estimated salvage £509,750.

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Rabies.—A case of rabies was confirmed on the 18th June, in an imported dog brought from India. The dog was landed on the 27th December, 1923, but died of rabies on the 13th June, nearly six months after its arrival in this country. Allowing for the period of the voyage the incubation period in this case must have exceeded six months. A notice detaining the companion dog imported with the rabid animal for a further period of one month, in quarantine, has been issued under the Rabies Order of 1919. This is the third case of rabies in imported dogs whilst undergoing quarantine during the current year.

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Exhibition at Heysel-Laeken (Brussels).—A National and International Exhibition of Novelties bearing on urban and rural household work will be held at Heysel-Laeken (Belgium) from 15th July to 15th August, 1925. This exhibition, organised with the collaboration of Government Departments local governments, agricultural associations and other Belgian organisations, has as its object to bring before housewives means of facilitating their work or increasing its efficacy, particularly through new or improved appliances. Exhibits are invited from inventors and manufacturers abroad, who are asked to enter as soon as possible, before 1st April, 1925. Entries should be addressed to the Secrétariat Général, 40, Rue des joyeuses Entrées, Louvain.

The Classes for exhibits are very comprehensive, including, for example, milking by machinery, garden equipment, kitchen and household apparatus, cleaning materials, furniture, sanitation, etc.

NOTICES OF BOOKS.

Agricultural Progress.—(The Journal of the Agricultural Education Association. London: Ernest Benn & Co., Ltd. Price 5s. net.) There has recently been published the first number of a new journal with the arresting title of *Agricultural Progress.* This publication is the official organ of the Agricultural Education Association—a body which, although founded in 1894, has not hitherto attracted public notice. The Association includes the great body of the workers engaged in agricultural education and research in England, Scotland and Ireland—Professors, Lecturers, and County Organisers—and, in a sense, may be regarded as the scientific brains of the agricultural industry.

It is interesting to learn that the Association was invited to give evidence before the Tribunal of Economists appointed by Mr. Bonar Law's Government. In the publication under notice, we find a memorandum embodying the main heads of the evidence given on behalf of the Association. It may be interesting to record the names of three witnesses actually selected to give evidence. They were Mr. James Mackintosh, of the National Dairy Research Institute, Reading, who dealt with possible economic advances in regard to milk production; Professor W. Somerville, who testified regarding grass improvement, a subject upon which he is an acknowledged authority; and Mr. James Brown, who was deputed to advocate the intensified system of forage farming, of which he is a well-known exponent. The extended title of the Memorandum above referred to is "The contribution of Agricultural Education towards the alleviation of the present Agricultural Crisis."

It is unnecessary to mention in any detail the specific remedial measures suggested in the Memorandum. Most of them have already been noticed and discussed at one time or another in the technical press. Growers of potato seed, however, should notice that the Memorandum envisages the possibility of producing seed in England equal to Scotch seed; for it is suggested that the existing superiority of the latter is mainly due to its being free from infection by virus diseases, such as leaf curl, mosaic, etc. It is also recommended that the growing of silage crops should be largely extended. A vigorous attack is made on the use of compound fertilisers and feeding stuffs, sold under proprietary names. The Fertilisers and Feeding Stuffs Act offers, it is said, insufficient protection, and it is suggested that legislation on the Canadian model should be adopted. In Canada every proprietary fertiliser must be registered with the Minister of Agriculture, together with a statement of the description of each material from which the fertiliser is made. The statement of the analysis only, unintelligible as it is to the average farmer, gives no protection so far as price is concerned.

When all is said, however, it must be admitted that the sovereign specific for present ills is largely a spiritual one, the fostering of a belief that human endeavour alone can, and will, provide a remedy. Hard work, both physical and mental, has not hitherto failed to "win through"; and hard mental work is not possible apart from a familiarity with the benefits that education and study alone can provide.

"Agricultural" progress is not a matter of the adoption of this or that nostrum; it will not be achieved until the industry is inspired as a whole by that spirit of confident adventure which animated the pioneers in Essex of whom the writer of the Memorandum speaks. This is not a counsel of despair: rather a message of hope for the future, and a seal of the past.

Modern Farm Machinery.—(D. N. McHardy, N.D.A., A.I.E.E., with preface by M. J. R. Dunstan, N.D.A., O.B.E. London: Methuen & Co., Ltd. Price 7s. 6d.) This work should prove useful both to farmers and students of agricultural engineering. Two opening chapters are devoted to the mechanical principles employed in farm machinery and to the materials and methods used in its construction. The author then deals at length with machinery and implements used on the farm and the main principles underlying their use. Subsoiling and rotary tillage have not been overlooked. A very useful chapter deals with the farm workshop, which is far too often neglected. The book is well illustrated and contains useful data regarding the utility and cost of operation of various machines taken from the reports of the Tractor Trials organised by the Society of Motor Manufacturers and Traders and investigations carried out by the Ministry during the last three years. An appendix contains various data of special value to the farmer who uses power.

The Agricultural Crisis, 1920-1923.—(R. R. Enfield. London: Longmans, Green & Co. Price 10s. 6d. net.) In this book Mr. Enfield has endeavoured to act the part of the unbiassed onlooker, and from the tangle of prejudice, misunderstanding and half-informed criticism that has passed for an explanation of agricultural events in this country in the last few years, has picked out the thread of truth, explaining the difficulties with which the British farmer has been faced. In clear language he deals with the broad aspects of the crisis, ignores details, which, however interesting, are not illuminating, and shows how monetary policy was at the back of the agricultural upheaval which took place between 1920 and 1923, not only in this country, but also in the United States.

The author takes for the basis of his argument the accepted fact that the depression in agriculture in this country has been caused by a violent overthrow of the normally existing balance between the prices of agricultural products and the cost of their production. Taking a series of years beginning with the period immediately before the War, he shows that the unbroken rise in the prices of agricultural produce up to 1919-20, and the fall which then set in, was not a phenomenon peculiar to this country, but was to be observed throughout Europe and America: that the upward and downward movement in the prices of commodities was not confined to agricultural products, but affected practically all articles of commerce: and that the fall in prices occurred almost at the same time in all parts of the world. With these facts to support him, he is able to demonstrate that the misfortunes of the British farmer were not due to the peculiarities of his particular market, nor to the effects of special legislation, but were the result of a cause that produced troubles equally in Great Britain and in California, in Poland and in Italy. This cause was the remarkable change during the period in question in the value or purchasing power of money: a change which was confined by no territorial limits, and which affected all commodities in the same way.

Inflation during the first part of the period improved prices, and produced a general feeling of prosperity: deflation at the end of the period brought prices down with a run, and was accompanied by severe depression in all markets. Mr. Enfield has much of interest to say with regard to the vexed question as to the extent to which the Governments of the more important countries concerned could, by a better monetary policy, have averted much of the trouble which the haste to return to the pre-war gold basis of currency occasioned, and this section of his book will be read with particular interest by those agriculturists who are interested in economics and financial questions. This part of the subject is dealt with in a particularly lucid manner, and technicalities which might obscure the argument in the eyes of some readers are successfully avoided.

After dealing with the cause of the crisis, and the effect of the crisis, the author goes on to indicate the lessons that can be learned from the experience that the critical years of 1920-23 have given to the farmers and the economists. He points out that it is the uncertainty as to the prices that will be realised by the farmer for his produce that cripples agricultural enterprise, and that no blessing would be greater from the farmers' point of view than the stabilisation of prices.

Orderly marketing, in Mr. Enfield's opinion, will do much to prevent extreme variations in prices, and he suggests that farmers and those interested *in the framing of agricultural policy should concentrate their attention on the* means by which orderly marketing can be achieved.

The book contains a number of well-drawn and interesting diagrams, and a special feature of it is the way in which American experience has been drawn upon to illustrate the arguments put forward.

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REPLIES TO CORRESPONDENTS.

Effect of Ultra-Violet Rays on Plants.—G.K. asks what is the effect of the ultra-violet rays on the growth of plants, and on mildew and pests. This question was submitted to Dr. Bewley, Director of the Experimental and Research Station, Cheshunt, and his reply is as follows:—

Reply: (1) Past investigators have studied the effect of ultra-violet rays on the processes of growth and assimilation in plants, but their results have not reached the stage of practical application.

It has been shown that these rays retard growth and inhibit elongation in such plants as the begonia, lobelia, and potato. Also these rays appear to assist assimilation, and certain bacteria are destroyed by rays between wave lengths 2,960 and 2,100 A°.V.

So far as I am aware experiments on a practical scale have not shown conclusively that the growth of plants is improved, or that they are made more resistant to disease by means of ultra-violet rays.

(2) In order to test the effect of replacing ordinary glass by pure silica plates, it would be necessary to erect two small glasshouses, one glazed with ordinary glass, and one with fused silica. Any effect on

the crop would be seen immediately. I do not think that this has ever been done.

(3) The most suitable kind of glass for glasshouse construction is 21 oz. Belgian blown, in sheets 20 in. by 18 in. Fourth grade quality is used and is supplied in cases, each containing 80 sheets. The chemical composition, thickness and colour affect the quantity and quality of light transmitted, but you will find the glass recommended the most suitable for glasshouse work. (Information on this subject is given in a recent book by Dr. Bewley, entitled, "Diseases of Glasshouse Plants," published by Benn Bros., Ltd., 8, Bouverie Street, London, E.C.)

It is our intention to investigate the physical and physiological side of glasshouse construction at the first possible opportunity.

Sub-soiling with Explosives.—I.M. asks for information as to the breaking up with explosives of a "pan" formed under waterlogged land.

Reply: Some trials carried out in the Cotswold Hills in 1912 are reported on page 79 of the *Scientific Bulletin of the Royal Agricultural College, Cirencester*, Nos. 4 and 5, 1912-13. The results were not very satisfactory, this being ascribed to the fact that the explosives brought the sub-soil to the surface. This seems more likely to occur when the soil is wet. Methods of operation are described in the *Agricultural Gazette of New South Wales* for May, 1913 (Vol. XXIV, p. 375), but in a later number of the same publication, December, 1918 (Vol. XXIX, p. 878), the State Department of Agriculture records its opinion that the cost is prohibitive and that "sub-soiling by explosives is not an operation which can be recommended in a general way." A Bulletin—No. 209 (1915)—of the Kansas Agricultural Experiment Station is unfavourable to the use of dynamite on heavy clays but admits its efficacy in the case of true "hard-pan." Speaking generally, the Ministry would not recommend the use of explosives, under ordinary conditions, in preference to the usual methods of sub-soil ploughing.

Further information as to the use of explosives might be sought from Messrs. Nobel, Buckingham Gate, S.W.1, who issue a pamphlet on the agricultural uses of explosives.

Shoddy and Silk Waste.—H.L. asks for particulars of experiments with shoddy wastes, wool and silk wastes, and seed cake as manure.

Reply: Results of trials in the use of shoddy are given in this *Journal* for March, 1915, page 1087, and in "Soils and Manures," by Sir John Russell, page 199 of the latest edition.

Silk waste is stated, on page 917 of this *Journal* for January, 1924, to be fairly rich in nitrogen (8-10 per cent.) but to be rather slow in action. This statement occurs in a review of Bruttini's "Uses of Waste Materials" and is repeated from that book. Probably, however, it should act rather better than shoddy; it is richer in nitrogen, and as a rule the richer substances are in nitrogen the better and quicker they act.

The Ministry is not aware of any English experiments with seed cake. An article on the subject by Dr. M. Rindl, Professor of Chemistry, Grey University College, Bloemfontein, appeared on page 628 of the *South African Journal of Industries* for December, 1923.

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Lewer, S. H.—British Poultry and Poultry Keeping: Handbook Produced for the Committee of the British Section of the World's Poultry Congress, Barcelona and Madrid, 1924. (112 pp. + 14 coloured plates.) London: "The Feathered World," 1924, 2s. [63.65(42).]

Sturges, A. M.—Practical Bee Keeping. (328 pp.) London: Cassell & Co., 1924, 10s. 6d. net. [63.81.]

Engineering.

Hardy, D. N.—Modern Farm Machinery. (235 + xviii pp.) London: Methuen, 1924, 7s. 6d. net. [63.17.]

Robb, B. B., and *Behrends, F. G.*—Farm Engineering. Vol. 1. Farm Mechanics. (470 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 12s. 6d. (62.)

Economics.

Enfield, R. R.—The Agricultural Crisis, 1920-23. (222 pp.) London: Longmans, Green & Co., 1924, 10s. 6d. net. [338.1.]

White, J. D.—Land-Value Policy. (225 pp.) London: United Committee for the Taxation of Land Values, 1924, 2s. net. [336.22.]

Evans, I. L.—The Agrarian Revolution in Roumania. (214 pp.) Cambridge: University Press, 1924, 12s. 6d. [333.5(4); 63(4).]

Horticulture and Fruit Growing.

Rhode Island Agricultural Experiment Station.—Bulletin 195:—On the Amount of Stable Manure Necessary for Vegetable Growing. (16 pp.) Kingston, 1923. [63.511.]

Vermont Agricultural Experiment Station.—Bulletin 232:—Sterility of Strawberries: Strawberry Breeding. (61 pp.) Burlington, 1923. Burlington, 1923. [63.41(c).]

California Agricultural Experiment Station.—Bulletin 373:—Pear Pollination. (36 pp.) Berkeley, 1923. [63.41(08).]

Plant Diseases.

U.S. Department of Agriculture.—Department Bulletin 1210:—Summary of Literature on Bunt or Stinking Smut of Wheat. (43 pp.) Washington, 1924. [63.24.]

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Leeds University and the Yorkshire Council for Agricultural Education.—Report No. 134:—Crown Rot of Rhubarb (*Bacterium Rhaponticum*). (28 pp.) Leeds, 1924, 6d. [63.23.]

Live Stock.

Southdown Sheep Society.—The Southdown Sheep. (95 pp. + 15 plates.) Chichester, 1924, 3s. 6d. net. [63.631.]

Texas Agricultural Experiment Station.—Bulletin 311:—The Influence of Individuality, Age, and Season upon the Weights of Fleeces Produced by Range Sheep. (45 pp.) Brazos County, 1923. [63.631.]

National Council of Pig Breeders and Pig Feeders.—Bulletin 2:—The Effect of Feeding Fish Meal to Pigs in the Production of Bacon. (8 pp.) London, 1924. [63.64: 043.]

Dairying.

International Institute of Agriculture.—Le Contrôle des Vaches Laitières dans Divers Pays. (134 pp.) Rome, 1924, Fr. 15. [63.711(b).]

International Institute of Agriculture.—Le Lait et ses Dérivés: Renseignements Statistiques sur leur Production et leur Mouvement Commercial. (145 pp.) Rome, 1924, Fr. 15. [63.7(00).]

SELECTED CONTENTS OF PERIODICALS.

Field Crops:

Crops for Ensilage, *A. W. Oldershaw.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 39-49.) [63.19832.]

Experiments with Cereals in Norfolk, *C. Heigham.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 166-173.) [63.3.]

The Laying Down of Land to Grass, *W. Somerville.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 11-28.) [63.33(*a*).]

Plant Diseases and Pests.

Potato Leaf Roll and Degeneration in Yield, *T. Whitehead.* (Ann. App. Biol., vol. xi, No. 1, April, 1924, pp. 54-72.) [63.23.]

Further Observations on Prevalence and Habits of *Oscinella frit*, Linn., *N. Cunliffe.* (Ann. App. Biol., vol. xi, No. 1, April, 1924, pp. 54-72.) [63.27.]

Live Stock.

Stock Farming on Arable Land, *W. R. Peel.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp, 11-28.) [63.6; 63.70.]

Beef Production, *T. B. Wood.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 60-72.) [63.62 : 043.]

Light Horse Breeding, *C. Richardson.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 60-72.) [63.61.]

The Merits of Home Produced Foods for Pig Feeding, *C. Crowther.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 174-193.) [63.64 : 043.]

The Value of Green Food for Fattening Pigs, *E. J. Sheehy.* (Jour. Dept. Agr. and Tech. Instr., Ireland, vol. xxiv, No. 1, May, 1924, pp. 28-41.)

Dairying.

The Protein Requirement of Milk Production, *J. A. Fries, W. W. Braman,* and *M. Kriss.* (Jour. Dairy Sci., vol. vii, No. 1, Jan., 1924, pp. 11-23.) [63.711.]

Practical and Economical Suggestions to Balance Supply and Demand for Liquid Milk, *J. C. Keevil.* (Jour. Brit. Dairy Farmers' Ass., vol. xxxvi (1924), pp. 80-89.) [63.71.]

The Manufacture of Blue-Veined Cheese, *L. J. Lord.* (Jour. Brit. Dairy Farmers' Ass., vol. xxxvi (1924), pp. 90-98.) [63.736.]

Cheddar Cheese from Pasteurised Milk, *E. R. Ranson.* (Milk Indus., vol. iv, No. 11, May, 1924, pp. 75-79.) [63.736.]

Buildings.

Various Types of Silos, *A. W. Oldershaw.* (Scottish Jour. Agr., vol. vii, No. 2, April, 1924, pp. 142-151 + 8 plates. [694.]

The Economic Adjustment of Air Space in Cow Sheds, *W. G. V. Glossop.* (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 73-78.) [63.6 : 69.]

Economics.

How to Adapt Methods of Farming to the Changed Conditions of Agriculture, *James Wyllie.* (Jour. Farmers' Club, April, 1924, pp. 39-60.) [338.1.]

Improved Methods in the Sale and Distribution of Farm Produce, *S. R. Whitley.* (Jour. Farmers' Club, May, 1924, pp. 61-76.) [381; 334.6.]

Our English Villages, *Lord Ernle.* (Quarterly Review, Jan., 1924, pp. 23-42.) [30.]

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NOTES FOR THE MONTH.

Crops and Live Stock in 1924.

A PRELIMINARY statement of the Acreage under Crops and Grass, and Number of Live Stock in England and Wales in 1924, compiled from the annual agricultural returns collected on 4th June, was issued by the Ministry on 8th August, and appears on pp. 593-5 of this issue of the *Journal*. The statement shows that, compared with last year, the arable area has fallen by 253,000 acres, while that of permanent grass has increased by 183,000 acres, and there is also an increase of 56,000 acres in the area of rough grazings. The area under corn is about 110,000 acres less than last year, the decrease being accounted for by wheat. Oats, mixed corn and peas show appreciable increases. Potatoes and roots were grown on reduced areas, as also were clovers and rotation grasses, but most of the minor crops were more largely grown than in 1923.

The number of horses on agricultural holdings has fallen by 49,000, but all other classes of live stock have increased. The number of cows and heifers is 48,000 more than last year's record figure and the number of calves is 78,000 more. Sheep number about 1,000,000 more than in 1923, and the increase in the number of pigs is remarkable, bringing the total to 3,227,000, or 448,000 above the largest number returned in any previous year.

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Agricultural Wages (Regulation) Act, 1924.

THE principal provisions of the Agricultural Wages (Regulation) Act, 1924, which received the Royal Assent on 7th August, are explained in the following notes.

The purpose of the Act is to "provide for the Regulation of Wages of Workers in Agriculture," and this is to be carried into effect by means of the establishment of local Agricultural Wages Committees and a central Agricultural Wages Board. These

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bodies will supersede the Conciliation Committees established under the Corn Production Acts (Repeal) Act, 1921. The operation of the Act is confined to England and Wales.

Agricultural Wages Committees.—In the first instance a Wages Committee is to be established by the Minister of Agriculture and Fisheries for each administrative county (other than London) in England and Wales, except in 15 cases where two counties are to be combined to form one Wages Committee area. Thus, 47 committees are to be established forthwith, but the number may be increased or reduced at the request of the committee or committees concerned. Each committee is to consist of representatives of employers and workers in agriculture in equal proportions, of two impartial members appointed by the Minister, and of a chairman appointed by the committee. The method of appointment of the representative members is to be laid down by the Minister in Regulations to be made under the Act, and he may also appoint the chairman if the committee fails to do so within a given period.

Agricultural Wages Board.—The Minister is also required to establish an Agricultural Wages Board for England and Wales. This body is to consist of representatives of employers and workers in agriculture in equal proportions, and of a number of impartial members appointed by the Minister. The latter are not to exceed in number one-quarter of the total membership of the Board, and one of their number is to be appointed by the Minister as chairman of the Board. As in the case of the Agricultural Wages Committees the Minister is to decide the method of appointment of the members.

In the case both of the Committees and of the Board provision is made for the reimbursement, on a scale to be approved by the Treasury, of expenses incurred by members in attending meetings of those bodies.

Minimum Rates of Wages.—The principal purpose for which the Wages Committees and the Wages Board are established is to fix minimum rates of wages for all classes of workers employed in agriculture. Such rates when fixed will have the force of law. The Act requires that in fixing rates the Committees shall, so far as practicable, secure for able-bodied men wages which are "adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the nature of his occupation." It is further provided that the rates may, at the discretion of the body fixing

them, be such as to apply to all agricultural workers, or to a special class of workers or to a special district, and that regard may be had to the varying conditions of the employment of the worker, *e.g.*, as to whether employment is by the day, week, month, etc., or according to the number of working hours. The committees are also empowered, if they think it desirable, to fix differential rates of wages for overtime employment. In fixing minimum rates of wages the committees are required, as far as is reasonably practicable, to secure a weekly half-holiday for workers.

The power and duty of fixing minimum rates of wages rest primarily with the Agricultural Wages Committees, which have also the power of cancelling or varying any rates previously fixed. At least fourteen days' notice must be given of any rates which they propose to fix, and any objections to the proposal lodged within that period must be considered before a final decision is arrived at. When this procedure is completed the committee must forward its decision to the Wages Board, which is charged with the duty of making an Order embodying that decision, and specifying a date, subsequent to the date of the Order, from which the rates become operative.

The Wages Board itself may only fix, cancel or vary minimum rates in the following circumstances:—

(1) When a wages committee has failed to fix a rate within two months of its establishment;

(2) When a wages committee fails to fix a rate in substitution for one which has lapsed or has been cancelled;

(3) At the request of the representative members of a wages committee.

The Minister has no power to fix, cancel or vary any minimum rates or to require a wages committee or the Wages Board to do so, but he may direct a wages committee to reconsider any rate which they have fixed.

Other Duties of Agricultural Wages Committees.—*Piece-rates.*—In addition to fixing minimum rates of wages for time work, the committee may, if they consider it desirable, fix minimum rates of wages for piece work. If, however, they do not fix such piece rates, it is open to any agricultural worker who is employed on piece work to complain to his committee that the rate at which he is being paid is insufficient to provide, in the case of an ordinary workman, a wage equivalent to that which he would earn at the minimum time rate fixed by that committee. On receipt of such a complaint, and after giving the employer an opportunity to state his case,

the committee may direct the latter to pay to the worker such sum as they consider is due to the worker by way of arrears of wages. Any sum so ordered may be recovered by the worker as a civil debt.

Permits of Exemption.—The committees also have power, in the case of any worker who is incapable by reason of "physical injury or mental deficiency, or any infirmity due to age or to any other cause" of earning the minimum rate applicable to his case, to grant him a permit exempting him from the minimum wage provisions of the Act. A committee may, if it so wishes, specify in the permit a rate of wages which is less than the general minimum rate, and any rate so specified becomes the minimum rate in respect of that worker, and failure to pay such rate renders an employer liable to proceedings as in the case of the ordinary minimum rate.

Allowances in Kind.—Agricultural Wages Committees must, if so required by the Minister by means of Regulations, define the benefits or advantages which may be reckoned as part payment of wages in lieu of payment in cash, and the values at which they may be reckoned for that purpose. Should a dispute arise with regard to such payments in kind a wages committee may give a decision, which is binding on the parties concerned.

Enforcement of Minimum Rates.—An employer who fails to pay to any agricultural worker in his employment wages at the minimum rate applicable to him renders himself liable not only to action in the civil courts for the recovery of the deficit but also to proceedings of a quasi-criminal nature. In the latter case he is liable, in addition to the payment of arrears of wages, to be fined up to £20 (twenty pounds) for each offence and in addition up to £1 (one pound) for each day on which the offence continues after conviction. Where such proceedings are taken the onus of proof rests with the employer, who must satisfy the court that payment has been made at not less than the minimum rate. Employers' agents as well as employers personally are liable to prosecution for infringements of the Act.

Effect of Minimum Rates on Existing Agreements.—Any agreement for the payment of wages at less than the minimum rate applicable under the Act, or for refraining to exercise any right of enforcing payment at such rates, is null and void. On the other hand the Act does not prejudice the operation of any agreement or custom for the payment of wages at a rate higher than the minimum rate fixed under the Act.

Appointment and Powers of Officers.—The Minister is empowered to appoint a secretary for the Agricultural Wages Board and a secretary for each Agricultural Wages Committee as well as officers for the purpose of investigating complaints and securing the proper observance of the Act.

Such officers are empowered to require the production of wage sheets and other records of wages, to enter premises for the purpose of making investigations under the Act and to require any worker, employer or agent to give information with regard to the worker's employment or wages. It is an offence under the Act to hinder an officer in the exercise of his powers, to refuse to produce documents or give information for which he is entitled to ask, or to produce false documents or give false information. The duties of officers also include the taking of proceedings in the courts against employers who fail to pay the minimum rates.

Definition.—For the purpose of the Act the expression "agriculture" is defined as including "dairy-farming and the use of land as grazing, meadow, or pasture land or orchard or osier land or woodland or for market gardens or nursery grounds."

Regulations.—As required by the Act the Minister, on 12th August, gave notice of the Regulations which he proposes to make with regard to the constitution, procedure and powers of the Agricultural Wages Committees and the Agricultural Wages Board. These draft Regulations provide that the representative members of the Committees and the Board shall be nominated, in the case of employers by the National Farmers' Union, and in the case of workers by the National Union of Agricultural Workers and the Workers' Union. A period of forty days must elapse before the Regulations can be made and action taken under them, and during that period any representations with regard to them may be made to the Minister in writing by any public body interested. Copies of the draft Regulations may be obtained on application to the Ministry.

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The New Wheat, Yeoman II.

THE Council of the National Institute of Agricultural Botany have offered for sale this autumn approximately 2,500 quarters of the new seed wheat, Yeoman II, bred by Professor R. H. Biffen, F.R.S., of the Cambridge University Plant Breeding Institute. The seed will be sold to farmers only through the trade, and tenders were invited from members of the Agricultural Seed

Trade Association, the National Association of Corn and Agricultural Merchants, the National Association of British and Irish Millers, and other established dealers in seed corn. On p. 419 of this *Journal* last month it was stated that among the new wheats available this season is Yeoman II, which was described as "similar to Yeoman in general characters and milling properties, but promising a higher yield." It is regretted that this scarcely represents the true facts, which are that the yields of the two wheats are approximately equal, but Yeoman II is superior to the old Yeoman wheat for milling purposes. It is very desirable that farmers should know how they are to identify genuine Yeoman II, and this is explained below.

Yeoman II is being introduced to take the place of the older Yeoman wheat. There are two substantial reasons for adding yet another sort to the list of wheats now grown in this country. One of these is that pure stocks of the older Yeoman, owing to admixture with other wheats, are getting difficult to obtain; and the second that Yeoman II is a better wheat.

The two Yeoman types are products of the same cross, namely, Browick x Red Fife. As seen growing in the field both show the same characteristic "dead level" appearance, owing to the fact that all of the ears reach to much the same height, both have the same sturdy straw which has proved so important a feature in carrying the large crops of grain which the older Yeoman has produced under intensive cultivation, and the cleanly foliage and stems show that the yield is not likely to be seriously diminished by the attacks of the common yellow rust. But useful as such appearances are as a general guide, they do not prove that Yeoman II should replace the older Yeoman. Where good sorts are being compared only a thorough series of trials can show whether one is better, on the whole, than another. The results of such a series are now available.

The yielding capacity of Yeoman II was tested out first of all by the Plant Breeding Institute on both gravel and clay soils on its farm at Cambridge. It was then tested at ten centres in different parts of the country by the National Institute of Agricultural Botany. These trials, which have been some of the most searching and accurate yield-tests yet made, show that the yielding capacity of Yeoman II is fully equal to that of the older Yeoman wheat. The grower of the new form can therefore rely on obtaining crops as satisfactory as those produced by the older one. But though the certainty with which heavy crops could be grown from the older Yeoman wheat was probably the chief

factor which led to its being so widely grown in a short period of time, the realization that there was always a demand for it amongst millers, even when other sorts were difficult to market, undoubtedly helped its spread.

The quality of the grain of the new Yeoman II has therefore been tested thoroughly. After chemical and physical tests in the laboratories at Cambridge had indicated that the quality was substantially better than that of the older Yeoman wheat large quantities of grain were grown on for comprehensive milling and baking trials. These were made by a special committee appointed by the National Association of British and Irish Millers. The greater part of the wheat they tested was from the crops grown at the ten centres already referred to in connection with the yield trials. It was produced therefore over as wide a range of soil and climatic conditions as would be met with in the wheat growing portions of this country. In the report made by this Committee is the following statement: "The bread by long or short baking processes is extraordinarily good of the so-called 'home-made' or 'farm-house' type. Its good flavour is remarkable, its bloom excellent, its crust first-rate of a rich brown colour. On these lines it surpasses anything we have tested for many years, and is incomparably superior to anything obtainable from average ordinary English wheat."

This opinion is based on the crops grown under the unfavourable climatic conditions of the year 1923. The analyses made that year by the Plant Breeding Institute indicate that some factor, possibly the lack of sunshine during the period when the grain was filling, had adversely affected the quality of wheat not only in the case of the new Yeoman II, but of all of the wheats under examination. It is therefore not unreasonable to expect that under more favourable conditions even better results will be secured. That this will happen seems almost certain, for in a series of tests made on the 1921 crop, Dr. Humphries obtained dough from the flour of Yeoman II of great elasticity and tenacity, and loaves approximating closely to those made from "No. 1 Northern" Manitoba wheat.

From the different points of view of growers, millers and consumers, Yeoman II should take the place of the older form.

The chief characteristics of the new wheat are: A clean healthy straw of medium height and good standing capacity; beardless white-chaffed ears of medium size when grown under average field conditions, squarely built but slightly less compact than those of Square Head's Master; grain long, red, and as a rule trans-

lucent; flour lively and granular, the behaviour of the grain in milling resembling that of the parent Red Fife.

Yeoman II, like the original Yeoman, is particularly suitable for growing on medium and heavy soils which are in good heart, and is specially recommended for the Eastern, Midland, and Southern Counties of England. It responds to good treatment and gives the best results when sown early. The Council of the Institute believe that farmers who intend to grow wheat under such conditions cannot do better than sow Yeoman II.

The attention of farmers is particularly drawn to the fact that genuine seed of Yeoman II can only be obtained in sacks closed with the seal of the National Institute of Agricultural Botany, thus:—

N.I. A.B.

The price to farmers will be £6 6s. per 4½ cwt. (*i.e.*, per quarter of 504 lb., or 8 bushels of 63 lb.).

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Prevention of Bunt in Wheat.

THOUSANDS of bushels of wheat are lost annually in England through neglect to pickle seed wheat as a protection against bunt. Most farmers know this, though they do not all take measures to prevent loss. Infection of a crop is almost certain if seed contaminated with the spores is sown. When a crop is thrashed many of the bunted grains burst, and the healthy grains become coated with the minute black spores. Winnowing may remove unburst bunted grains and broken fragments of them, but it cannot free the grain from adhering spores. Grain may also become contaminated by spores from thrashing machines used previously to thrash an infected crop; while dirty sacks have been known to contaminate seed corn placed in them.

When the seed is sown both the grain and the bunt spores germinate, and the fungus invades the seedling wheat plant before it appears above ground, growing with it and maintaining itself near the growing tip of the plant. Later it finds its way into the young grains in the ear, eventually producing

a softish stinking mass of black spores covered by the skin of the grain.

The pickling of seed wheat with diluted formalin has been found reliable as a preventive. The Ministry recommends the use of this, the strength being at the rate of 1 pint of formalin to 40 gallons of water. Details of the treatment are given in Leaflet No. 92, obtainable from the Ministry.

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Broadcasting Agricultural Information.

FROM the beginning of October next the Ministry has arranged with the British Broadcasting Company to issue from their headquarters in London a regular fortnightly bulletin containing information designed mainly to assist and interest agriculturists and others concerned in the land and its cultivation. About 15 minutes will be taken up by each fortnightly message, which will deal briefly with the main tendencies of the chief markets, will offer observations on such matters as the methods employed in current agricultural practice and will include a short talk on some special seasonal topic. This talk will be prepared with a view to its being of interest not only to the agriculturist, but to others of the larger public who live in the towns.

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Agricultural Co-operation.

THE past few weeks have witnessed two important events concerning agricultural co-operation in this country. One is the conference on "Agricultural Co-operation in the Empire" at the British Empire Exhibition, under the auspices of the Horace Plunkett Foundation, and the other the Annual Meeting of the Agricultural Organisation Society, at which a Resolution was passed instructing the Governors to wind up the general work of the Society. The juxtaposition of these events is fortuitous and carries no intrinsic significance; yet each may exercise a very far-reaching influence on the future of agricultural co-operation in this country.

The Wembley Conference afforded a valuable and long overdue opportunity for the interchange of views and experiences regarding the principles and practice of agricultural co-operation between those associated with the movement in these islands and the representatives from overseas. Of the various forms of co-operative endeavour to which the conference devoted its attention, the problems associated with the co-operative marketing

and the representatives from overseas. Of the various forms of regarded as the most important. The addresses delivered by the Dominion representatives on this question were both illuminating and impressive, and showed the high pitch of economic organisation which has been attained amongst farmers in their respective countries. The conference at Wembley has indeed, only emphasised what has been becoming increasingly clear in the last few years, namely, that the relation of producers overseas to their markets is undergoing a profound change. The overseas producers appear to be firmly convinced that, in the sale of their produce, they must, in some manner, have the advantage of mass selling which is enjoyed by every other industry, and, further, that they can only attain that advantage co-operatively. It is true that the Dominion representatives spoke of supplementing, rather than of competing with, supplies produced here at home, but it is clear that so long as the system of selling in this country is essentially competitive, large-scale operations designed to improve the efficiency and effectiveness of the machinery for marketing overseas' supplies in this country may have important reactions in the home-market which the British farmer will sooner or later have to face. Pertinent examples of what organisation has been able to effect will be found in the speech made at Wembley by the Hon. Charles A. Dunning, which is reprinted slightly reduced at p. 530.

It is important that the disappearance of the Agricultural Organisation Society should not connote a cessation of effort in the direction of organising the farmers of this country for their own benefit. Indeed, consistent with the march of events, the agricultural co-operative movement cannot and will not stand still. There is, however, important work to be done, which may well call for the intervention of a body more widely representative, and more powerful in its influence than the Agricultural Organisation Society could ever hope to be. The advocates of dissolution at the meeting of the Agricultural Organisation Society were under no delusion in this respect, and were of opinion that a way should be found to carry on the torch which the Society had so honourably lighted.

The Government, as is now well known, recognises the great importance of the economic organisation of the agricultural industry, especially as regards the marketing of produce, and, through the Ministry of Agriculture, is prepared to advance money on favourable terms to co-operative enterprises organised mainly for that purpose.

In addition, the Agricultural Credits Act provides facilities which will enable agriculturists who will co-operate for that purpose to obtain credit to meet such expenses as the purchase of seeds, fertilisers, feeding stuffs, etc. Much is also hoped from the careful and intensive survey which the Ministry of Agriculture is about to undertake of the whole region of marketing and its associated problems. These are important aids, which should facilitate such constructive work as may, in future, be put in hand by farmers themselves.

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Home-Grown Sugar Industry.

THE Government's proposals in respect of the sugar beet industry, as recently announced by the Chancellor of the Exchequer, are briefly as follows:—A direct subsidy will be given from the Exchequer on sugar produced from home-grown beet, to the amount of 19s. 6d. per cwt. for four years, including the present year, then 13s. per cwt. for three years, and 6s. 6d. per cwt. for a further three years. The Excise duty, from which the home producer is at present exempt, will be reimposed. The net effect of these proposals will be to give the home sugar industry a total advantage of 21s. 5d. over foreign imported sugars, instead of 11s. 8d., as at present; an advantage which can be very little affected by any further reduction in the sugar duty. The industry will now know exactly what it will receive by way of State assistance over the whole period of ten years, and, with the removal of any uncertainty as to the future, the factor which has, up to the present, been largely responsible for retarding the development of the industry will disappear.

The Government consider that, with this assistance, the manufacturers should be able to pay the farmer during the first four years of the subsidy period not less than 44s. a ton for beet of $15\frac{1}{2}$ per cent. sugar content delivered to a factory, and this condition will be attached to the subsidy. In actual fact it should be possible with sugar at its present price for a good grower to earn at least 50s. a ton for his beet under the contract system which is in force at existing factories, and he would benefit by any rise in the price of sugar. With a fixed minimum price the farmer will be insured against a serious fall in the price of sugar, and the inexperienced grower will be able to reckon on a sufficient return during the period in which he is learning how to increase his yield and improve the quality of his crop.

THE PRACTICAL AIMS OF THE DAIRY FARMER.

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THE chief practical aim of the dairy farmer must of necessity be the same as that of any other business man who invests his capital in some form of industry, namely, the obtaining of the largest average net profit over a period of years.

This aim can only be realised by good all-round management, and farm management includes many operations of very diverse character, such as purchase of livestock, feeding stuffs, manures, etc., of the kinds most suitable for the farm in the most economical manner; efficient organisation of labour; selection of the most suitable crops, followed by adequate cultivation and good judgment at harvesting; wise use of home-grown and purchased foods; careful treatment of all kinds of livestock, and the sale of milk, dairy produce, surplus stock and crops in the most advantageous manner.

The second practical aim of the dairy farmer must, therefore, be successful management of those branches of the farm organisation which contribute most largely to the annual expenditure and the annual receipts. It is difficult to arrange these branches in a generally accepted order of importance, and fortunately this is not essential; some stand out clearly as absorbing major portions of the annual payments—*e.g.*, purchase of feeding stuffs, manures and seeds, occasional purchases of in-calf heifers and cows, and expenditure on labour; others are equally definite as the chief contributions to the annual income, *e.g.*, sale of milk and dairy produce, surplus livestock and surplus crops. In addition to the actual buying and selling, there is the important work of using the commodities purchased in the most advantageous manner for the production of the goods to be sold. This article will, therefore, be devoted to a brief consideration of the aims of the dairy farmer in each of the above-mentioned branches of farm management.

Purchase and Use of Feeding Stuffs.—Numerous investigations have shown that the cost of purchased feeding stuffs is one of the largest items in the cost of milk production, hence the need for careful study of the composition and nutritive value of available cakes and meals in relation to price and

suitability for use along with home-grown foods. The aim of the farmer should be to provide a balanced ration of suitable foods at the minimum cost. The home-grown foods—hay, straw, roots, silage, cereal grains, beans, etc.—usually constitute the bulk of the ration, and purchase of other foods must be made in accordance with the supplies already on the farm. Space does not permit of a detailed discussion here of the principles and practice of feeding, but every dairy farmer ought to have for easy reference,* information on (a) the composition of feeding stuffs; (b) the work done in the animal body by the different constituents—albuminoids, oil, etc.; (c) at least one method of valuing feeding stuffs according to their analysis; and he should also be familiar with the so-called feeding standards for milk production which specify the quantities of food needed to maintain the dairy cow in ordinary condition and to produce a given quantity of milk. The use of these feeding standards, combined with a knowledge of the composition of feeding stuffs has given excellent results in the compounding of rations and in lessening the cost of milk production in many countries.

One instance of the value of such knowledge may be given. In the early winter of 1923 two of the cheapest feeding stuffs on the market were rice meal (£7 per ton), and extracted undecorticated ground-nut meal (£6 15s. per ton). Reference to the analysis of these foods showed that the former contained: albuminoids 13 per cent., oil 13 per cent., and carbohydrates 50 per cent.; starch equivalent, 72. The latter contained: albuminoids 32 per cent., oil 2 per cent., and carbohydrates 22 per cent.; starch equivalent, 45.

When mixed in equal proportion by weight, the mixture contained $22\frac{1}{2}$ per cent. albuminoids, 7 per cent. oil, 36 per cent. carbohydrates, with a starch equivalent of 58.5, and cost £6 17s. 6d. per ton. A further study of tables of food compositions showed that the percentage of digestible albuminoids would be about 17, and this percentage, with a starch equivalent of 58.5, would give a fairly well balanced mixture for milk production; one, in fact, which would fit in very well with an average maintenance ration of home-grown roots and hay. With regard to price, comparison with other feeding stuffs showed that, with two exceptions, the above-mentioned mixture was obtainable at a price per ton appreciably lower than any other single food or mixture of foods of similar composition on

* Miscellaneous Publication No. 32 (*Rations for Live Stock*), obtainable from the Ministry, Price 6d., post free.

the market; in fact, numerous other foods with similar percentages of albuminoids and oil were quoted at £9 or thereabouts per ton. The exceptions just referred to were palm kernel (extracted) meal, and palm kernel cake. A glance at the composition of these foods, however, showed that either of them could be used in equal proportions along with the rice meal and ground nut meal and the resulting mixture would still be well balanced for cows in milk; for example:—

	Albuminoids		*Oil*	*Carbo-hydrates*	*Fibre*	*Starch Equiv.*
	Total	*Digest.*	*Total*	*Total*	*Total*	*Total*
Rice Meal	13	7	13	50	7	72
Undec. Extr. Ground Nut Meal ...	32	27	2	22	24	45
Extr. Palm Kernel Meal	19	16	2	49	16	71
Mixture	21.3	16.6	5.6	40.3	15.6	62.6

The percentage of indigestible fibre in the above mixture is higher than is desirable for heavy milking cows, but for average herds a mixture of the above composition has been proved quite satisfactory. Other mixtures containing less indigestible fibre and consisting of more appetising ingredients could easily have been made up, but when the relative costs per ton were compared, the advantage on the side of the cheaper mixture was a strong argument in favour of its use, at least for the first three gallons produced per cow. Cows giving higher daily yields could be given a more appetising mixture for the gallons yielded over three per day.

The fact that in one season market prices of feeding stuffs should vary so much that one or two properly balanced mixtures can be obtained for fully £2 per ton less than other foods of similar analysis constitutes a very practical reason why dairy farmers should have a knowledge of the principles and practice of rationing for milk production. Consideration should also be given to the probability that feeding stuffs can be purchased more cheaply during the summer than during the winter, and it is certain that the price per ton can be cut somewhat when an order is given for a large quantity of one kind of food. There is a certain amount of risk in buying forward, but on the average the purchaser gains; it is usually possible to get sufficient information during the summer as to the trend of prices, and it is preferable to consider groups of alternative foods rather than individual varieties.

There is a wealth of evidence that the important point in a ration is the correct balancing of the albuminoids, carbohydrates,

etc., rather than the inclusion of any one or two particular foods, and the object of the farmer should be to purchase such foods as will give a properly balanced ration in conjunction with those grown on the farm.

The benefit obtainable by purchasing a large quantity of any food is fully appreciated by the large farmer, but this advantage can also be obtained by those farming on a smaller scale if they will agree to use the same foods and pool their orders. This can be done privately, but a large development of this principle should lead to the formation of a co-operative society to organise purchases on a still larger scale.

Purchase and Use of Manures and Seeds.—The amount spent annually by the dairy farmer on manures and seeds is as a rule materially less than the expenditure on purchased foods, and the importance of these items in the annual expenditure will naturally vary according to the proportion of arable and grass on the farm.

The principles governing the selection of manures for different soils and crops are now generally understood, and information on the current prices per unit is easily available as a guide to the farmer in the purchase of his requirements. It is nevertheless desirable to emphasise two points; firstly, the importance of obtaining manures of high grade and reliable quality, and, secondly, the comparison of the cost per unit when the railway carriage, cartage and cost of application is taken into account in addition to the first cost of the manure. For example, a grade of basic slag with 20 per cent. total phosphate may be quoted at 41s. per ton, equal to 2.05s. per unit, and a grade with 34 per cent. total phosphate at 63s. per ton, equal to 1.86s. per unit. These figures show only a slight difference in favour of the higher grade, but further consideration shows that 6 tons of the latter will supply as much phosphate as 10 tons of the former. The purchase of the higher grade, therefore, means a distinct saving in railway carriage and cartage, and in the cost of application per acre.

With regard to the purchase of seeds all that need be said here is to urge the importance of buying always clean seed of excellent quality.

Purchase of Heifers, Cows and Bulls.—From the point of view of the prospective dairy farmer the purchase of heifers and cows to constitute the foundation of a herd is of the greatest importance, and were this article written primarily for beginners, this subject would have received first consideration. On the

other hand a very large number of dairy farmers are able to maintain their herds by the introduction of home-bred stock and rarely purchase heifers or cows. Where such a course is possible it is in the writer's opinion the best method of maintaining a herd because of the possibility of improvement in milk yield and breed type from year to year, but this improvement will only be gained if great care is given to the choice of a stock bull. In breeding herds, therefore, one of the chief practical aims is the selection and purchase of a bull with a view to the breeding of heifers of greater milking capacity and of better type than their dams.

In the selection of heifers and cows for the commencement or maintenance of a herd, attention should be directed chiefly to the age, type, breeding (including if possible the milk records of the parents), and place of origin. Many dairy farmers prefer always to purchase first-calf heifers and this course has much to recommend it, because heifers purchased at or soon after calving give an immediate return for their keep, are usually healthier than older cows, and, should they prove unsatisfactory as milkers, they can be disposed of at a price which shows little or no depreciation on their original cost. The quantity of milk produced by a herd of first-calf heifers is not equal to that produced by a herd of mature cows, but the greater risk of a considerable depreciation in the value of the latter usually turns the scale in favour of the younger animals. Where second-calf cows can be purchased from a healthy herd, they may be preferred to first-calf heifers because they will give larger yields, and the shape and size of the udder and position of the teats can be seen better.

Milk recording has made great progress in recent years, but as yet records are not available in respect of the dams and grand dams of the great majority of heifers available for purchase, hence purchasers must depend on selection by external characteristics—conformity to breed type, size, constitution and healthiness, and potential milking capacity as denoted by udder and milk vein development. In this connection it is interesting to note that one of the American Agricultural Experiment Stations has recently published the results of a comprehensive study of the relative importance of the different milk yield "indicators" in the Jersey breed. The degree of correlation between the actual yield, as shown by lactation records, and the conformation of different parts of the body as measured by the marks awarded on a score card basis, was found to be

surprisingly wide; the most reliable indicators were found to be: (1) the milk veins, which should be large, tortuous, and elastic; (2) the hindquarters of the udder, which should be well rounded and well out and up behind; (3) the udder, which should be of large size and not fleshy; and (4) the body, which should be wedge-shaped with deep large paunch, legs proportionate to size and of fine quality. The same investigators, however, point out that the actual yield of milk as found in a seven-day period a few weeks after calving is *twice as accurate* an indication of the cow's ability to produce milk as any external features or "points" of the animal.

It is highly probable that these conclusions are also largely applicable to other breeds, and the value of milk records in the sale and purchase of dairy cattle is thus confirmed from another point of view. The purchaser of dairy stock is therefore less likely to be disappointed in his purchases if he selects stock privately from milk-recorded herds or from complete dispersal sales of such herds. He must, however, study the published records closely, remembering that information as to the milk yields, number of days in milk, and dates of calving for two or three successive years are a much more reliable basis for judgment than the yield for one year or lactation period only.

To the owner of an established dairy herd, the selection of a young bull is one of the most important practical points. The only true means of improvement of a herd is by breeding, and the test of improvement is that the home-bred heifers should be better animals and better milkers than their dams; the chief agent in this improvement must therefore be the bull. If we assume that the dairy farmer on the look out for a young bull can be relied on to make a good selection on the basis of external appearance according to the points of the favoured breed, there are at least two other points which should be studied. The first is the dairy characteristics of the bull's dam and, if possible, his grand dams; these cows should be of good breed type, healthy, and with well-developed shapely udders and teats. The second point is the milk records of the dam and grand dams; these should be studied in detail as specified above in regard to the records of cows, remembering that an average of, say, 9,000 lb. over three successive years is a more valuable indication of constitution and milking properties than a one year's yield of 11,000 lb. to 12,000 lb. A third point which should be studied in some instances is the percentage of fat in the milk of the dam and grand dams. On this point there

will most probably be little or no information obtainable, but nevertheless there are good reason why intending purchasers should persist in asking questions on this point. It is well known that as a rule (though fortunately there are occasional exceptions), heavy milking cows yield milk of less than average quality, hence the continued selection of bulls on the basis of milk yield only will tend to lower the average quality of the milk produced by the herd and increase the risk of trouble with the local authorities responsible for the administration of the Food and Drugs Acts. To many dairy farmers the main object is to get an increased yield from their herd, and if the use of a bull, the son of a heavy-yielding dam whose milk averaged only 3 per cent. of fat, would ensure an increase of 100 to 200 gallons per cow, they would take the bull and risk any trouble in respect of quality. There are, however, many others who have already high herd averages, and in such cases the quality of the milk should receive attention; buyers of milk are likely to have an increasingly wide field of producers to select from, and discrimination may be exercised to the disadvantage of those whose milk is troublesome in respect of quality.

Management of the Dairy Herd.—A dairy herd is kept for the purpose of producing milk, hence the management should include all those details which experience and research have shown to be advantageous and economical. Milk recording has proved its value in hundreds of cases as a means of improving the average yield and thus giving a larger sale of milk from the same number of cows with the same expenditure on labour and other overhead charges. Butter-fat testing in herds where the milk is made into butter or cheese has also shown how the output from the herd can be increased, and where young bulls are sold for stock purposes, information as to the fat percentage in the milk of the dam may enable a higher price to be obtained. Service and calving records should be carefully kept to enable cows to be dried off in preparation for the following lactation period, and times of service should be regulated so that cows will calve at the time when the maximum production of milk is most desirable or when it is most profitable.

All cows should be marked by tattooing or some other method so that they can be identified, and all calves reared for stock purposes should be similarly marked and a record kept of the tattoo number or markings so that they may be identified and their ancestry traced when necessary. Failure to mark calves

so that they can be identified later has caused numerous herd owners to lose many years in the grading-up of stock for registration in the Breed Herd Book. Milk Recording Societies, operating under the regulations of the Ministry of Agriculture, now undertake the tattooing of calves and keep the necessary records, and membership of one of these societies affords the easiest and most reliable means whereby records of milk yields, butter fat percentages, calving and service dates and the tattoo numbers of cows and young stock can be obtained. The cost of membership is not great and, though the farmer must at present consider carefully every item of expenditure, the money spent on milk recording and calf marking should be looked on as a good investment, for there is no doubt that in the course of time it will return a highly satisfactory rate of interest.

Another important aspect of herd management is the maintenance of a thoroughly healthy dairy herd—free from contagious abortion and tuberculosis, and with the minimum of udder troubles. Probably the most effective precaution which can be taken to prevent outbreaks of contagious abortion is to rear sufficient young stock to maintain the herd, thus making purchase of female stock unnecessary and to keep a bull for the herd. The same procedure is also very desirable when a tubercle-free herd has been obtained through the application of the tuberculin tests and elimination of reacting animals. In spite of the criticism still occasionally directed against the tuberculin tests there is a steady increase in the number of practical dairy farmers who are convinced that the application of the tests and action according to the results obtained is well worth while, because in addition to freedom from tuberculosis, herds of non-reacting animals are healthier in every other respect. With regard to udder troubles the chief precautions are close observation, immediate treatment of every affected quarter according to the nature of the trouble, isolation of the cow when necessary and particular attention to cleanliness in housing and milking.

In all matters affecting the health of a herd the advice and assistance of a veterinary surgeon should be sought without hesitation, and there can be no doubt that the circumstances are most favourable to successful treatment in herds of home-bred stock (where the life history of each animal is known), housed, fed, watered and milked under cleanly conditions.

Organisation of Labour.—On many farms the wages bill is the largest single item in the annual expenditure. The first

essential is to get one or more good men who understand the work of herd management and of land cultivation, and who are not afraid of responsibility. A good herdsman or head cowman is well worth good wages; if his duties and responsibilities be considered in detail it is at once realised that no expenditure by the owner of time and money in the selection and breeding or purchase of valuable dairy stock, or in the provision of model equipment can ensure success without the wholehearted co-operation of the men who feed, milk and attend to cows at calving time, deal with cases of udder trouble and the numerous other small but nevertheless important items in the management of a dairy herd.

The only school from which such men can be obtained is that of experience, and although occasionally it may be imperative to make a change in order to get a more reliable staff, as a rule the problem before each farmer is to consider what steps he can take to arouse a greater and more intelligent interest in their work on the part of the men he already employs.

Assuming that the farmer himself is keenly interested in the welfare of his herd and in all details of herd management, there are a variety of ways in which the interest of the men may be developed. The bonus system may be introduced in some suitable form and additional payments made on the basis of the number of calves born, or the number of cows attaining yields of 10,000 lb. of milk per anum or lactation period, or on the total output of milk. There are objections, however, to giving a bonus in connection with the usual duties of the cowmen or milkers. A good man should not and does not require special payment as an inducement to give a calving cow special attention, and where bonuses have been paid on a milk yield basis, instances have been known of the records having been inflated. At the same time the bonus system may be most helpful in some instances, for example, in the production of graded milk, where the amount of the bonus can be made dependent on the bacterial count. Success in clean milk production depends primarily on the manner in which the routine work of washing and sterilising utensils, cleaning cows and milking is carried out, and as the degree of efficiency in this work is determined by the bacteriological content of the milk, a bonus payable on such a basis is only paid when there is independent evidence that a high standard of work has been attained.

The introduction and development of milk recording has done much to improve herd management and to make the twice daily

task of milking more interesting. The daily or weekly weighing of the milk institutes a measure of progress and a basis of comparison which was previously lacking, and on many occasions the writer, when doing milk recording work has been struck with the interest shown by the milkers in the yields of different cows. Any suggestion which might mean an addition to the number of milk recording forms issued under the Ministry of Agriculture's scheme can only be made with great reluctance, but nevertheless a card, which should be kept in the cowshed, so ruled as to show the amount given each week and the total to date for each cow in the herd would be a handy record for the owner and would be greatly appreciated by the men. In many cases the milker knows the highest daily yields of the cows he milks, but is never informed of the total yield in a year or lactation period.

In respect of feeding much can be done by the farmer in selecting the kinds and quantities of foods which will give a suitably balanced ration, and in a system of feeding in relation to milk yield, but the giving of the allowances of concentrates, etc., at each meal, must be left to the cowman, and in the case of heavy milking cows there are times when it is most important to have a man who knows when to depart from the usual system; in other words, the man who actually feeds the cows has as much need for knowledge of the composition and effects of the different foods as the man who grows or buys them. Much can be done towards supplying this knowledge by distributing the Ministry's leaflets and Agricultural College bulletins on foods and feeding, but attendance at a lecture or course of lectures is much to be preferred. On several occasions when arranging the time of a lecture on the feeding of dairy cows, the writer has been asked to agree to an hour which would permit of the attendance of cowmen as well as farmers, and such meetings have invariably been well attended and followed by acute and interesting discussions. There is room for a wide development of this principle. The great majority of herdsmen and milkers are truly interested in their work, and a more extensive co-operation between the farmer and the County Agricultural Education Authorities with a view to providing short courses of instruction in dairying districts on such subjects as rationing of dairy cows, secretion of milk and milking, cleaner milk production and first-aid treatment in common diseases, particularly of the udder, will be very much appreciated and cannot fail to give the men a more intelligent understanding

of their work and ensure better management of the dairy herd.

Management in Relation to Sale.—*Milk.*—The chief product which the dairy farmer has for sale is milk, and the method of sale is to a great extent governed by the position of the farm in relation to a market. Where the farm is situated close to a large centre of population there are two alternatives: (*a*) to sell by retail direct to the consumer: (*b*) to sell wholesale to a retailer. Where the former method is adopted the farmer gets a higher price because he undertakes the work of distribution as well as that of production, and should get a profit on both branches. On the other hand the distribution of milk direct to the consumer's house requires great attention to detail, and may well be quite as worrying as the management of a herd of dairy cows. Provided that the farm is in a suitable position for the development of a retail business, it may well be that the deciding factor is the temperament of the farmer himself. To many it is sufficient to undertake the production side of the industry, and be content with the producer's profit; to others, including those in whom the business instinct is more highly developed, the probable extra profit is a deciding factor, and they undertake the labour and worry of the distributing side of the business in order to obtain this extra return.

Where the farmer is also the retailer he should make a study of the practical details of this business, including the organisation of delivery rounds to save as much labour as possible, the handling of milk to ensure uniform quality, the best mode of delivery—whether from a churn or by can or bottle—and the washing and sterilisation of all utensils to avoid the delivery of milk which will sour quickly. In addition he must master the art of maintaining good relations with his customers, and be ever on the look-out for new ones. If the supervision of these details cannot be undertaken by the farmer himself, he must employ an efficient manager who will be able to hold his own in competition with the man who is a retailer only and who is therefore able to devote his whole time to this work.

Generally, however, the dairy farmer is not a retailer of his own produce; he sells his milk wholesale, because the distance of his farm from a market leaves him no other practical alternative, or he makes it into cheese or butter on the farm. The price he receives is of paramount importance, but he has also responsibilities in the milking of the cows and handling of the milk, and the manner in which this work is done has a direct bearing on the trade value of the milk itself. No one will contend that milk which goes sour within twelve to twenty-four hours is worth

as much either to the distributor or the consumer as milk which will keep sweet for forty-eight hours or more, and it is therefore the business of the farmer to take all practicable precautions to produce a wholesome and good-keeping milk. The distributor and the householder must share the responsibility for the condition of milk up to the time it is used, but undoubtedly the farmer must take the first steps, which consist in seeing that the cows are cleaned before milking, that the utensils through which the milk passes are clean and sterile, that the milking is done in a cleanly manner, and that the milk is immediately cooled to as low a temperature as possible and kept cool and protected from heat and dust before, and, if delivered by the farmer, during conveyance from the farm. Much study has been devoted to the handling of milk on the farm in recent years,* with a view to discovering the simplest and most effective methods, and the latest information is easily obtainable on application to the agricultural educational authorities in each county, or the nearest agricultural school or college.

With regard to price, often there is little that the individual farmer can do to obtain a higher figure. The distribution of milk covers such a large series of operations from the farm to the consumer, and the quantity to be dealt with is so immense and yet so fluctuating, that large wholesale or retail organisations have grown up to undertake this phase of the business, and as these firms have also to deal with the seasonal surplus milk they are in a very strong position when negotiating on prices with a single farmer. The only way in which the farmer can hold his own is by co-operating with other farmers who also have milk to sell, and much has been done in this direction by the National Farmers' Union. The scheme of prices and quantities agreed on by the Committee composed of representatives of this Union and of all the distributors' organisations has proved quite workable and has helped greatly to stabilise the industry during the last two years.

Farmers must always remember, however, that the distributive or manufacturing sections of the industry will not purchase more milk than they can dispose of at a profit, taking one year with another, and that the fixing of a price by agreement for the country as a whole, with modifications according to areas, does not necessarily mean that there is a market for every individual farmer's milk. Milk production is undoubtedly increasing throughout the country: the purchase and use of milk

*Miscellaneous Publication No. 41 (*Studies Concerning the Handling of Milk*), obtainable from The Ministry, Price 1s., post free.

by the public must also increase, otherwise many producers may find that milk of the cleanliness and keeping quality which they produce cannot find a profitable market. It would appear therefore that it should be part of the practical farmer's policy to do all he can to increase the consumption and use of milk, and to take great care that the milk he himself produces is such that the purchaser will wish to drink and use more of it.

There is also the possibility of producing a higher grade milk which will command a higher price. Since 1915 licences to describe milk by special designations have been obtainable from the Ministry of Food, and later from the Ministry of Health, and the possessors of these licences have as a rule obtained a higher price for their milk. The question at once arises, "Is the increase in price sufficient to meet the increase in the cost of production involved in complying with the regulations under which such licences are granted?" In many instances the answer is undoubtedly—Yes. There is also an increasing amount of evidence that where, in order to obtain a Grade A (Tuberculin Tested) Licence, or a Certified Licence, an owner has eliminated all cows and heifers in milk which react to the tuberculin tests, the standard of health is definitely raised in the herd as a whole and losses are materially lessened.

Cheese and Butter.—Where the milk is made into cheese on the farm, the sale of the cheese is in the hands of the farmer. The price obtainable for English hard-pressed cheese is, however, influenced by the price of imported cheese, and where the home-made product is of second-class or inferior quality it is increasingly subject to very keen competition. The choicest qualities of the well-known English varieties have always commanded good prices, and will continue to do so; it appears obvious, therefore, that the farmer who makes cheese should do all he can to maintain and improve the quality of his product and also join with others interested in this branch of the industry in making known to the public the merits of English cheese, so as to increase the demand. It must, however, be recognised that advertisement will do more harm than good, unless the high quality and uniformity of the product can be assured.

In respect of butter, it is estimated that 32 per cent. of the milk produced in Great Britain is used for butter-making, but there is no doubt that in many districts this course is followed in order that the separated milk may be available for the raising of stock, rather than for the direct returns received from the sale of the butter. Numerous private dairies make butter of the highest

quality which is disposed of at a satisfactory price, but farm butter as a whole is so varied in colour, flavour and keeping qualities that it cannot have more than a local market. Where the quantity of milk to be made into butter is sufficient to provide a regular supply winter and summer, and no other outlet for the milk is available, then every effort should be made to produce butter of the best quality and to find a market amongst those who are prepared to pay an adequate price for a first-class home product.

Surplus Stock.—Little can be written which will help farmers in the sale of animals which are depreciating in value, and there are usually a few such in every dairy herd. On many farms where a breeding dairy herd is kept, however, it may well be worth while to rear a large proportion of the heifer calves, partly in order to have a larger number to select from for maintaining the herd and partly because there is usually a good demand for dairy heifers, either when fit for service or down calving. Surplus stock of this sort may be a valuable source of income, and if the milk records of the dam and sire's dam are good enough to be published, then the market price of good animals is further enhanced. There is also a steady demand for in-calf heifers and young cows which have passed the tuberculin test, and when animals of the right type and breeding are to be sold, their market value will be increased if they are offered for sale with certificates that they have passed the tuberculin tests required by the Ministry of Health for entry into Grade A (Tuberculin Tested) and Certified Herds.

Conclusion.—The chief practical aim of the dairy farmer was defined at the commencement of this article as the obtaining of the largest average net profit over a period of years. It was pointed out that this end can only be attained by good-all-round management in respect of purchases and sales, in utilisation of the land and other raw materials for production, and in the organisation of labour. Many points in such management have been discussed in detail above. It is now only necessary to emphasise that this does not mean a conservative stay-at-home policy. Interest, enthusiasm and personal attention to principles and occasionally some details on the part of the farmer himself are essential to good management, but it is also desirable that the farmer should take a judicious share in the farming activities of his district and in the work of the local Agricultural Society and the County Milk Recording Society; he should also visit experimental farms and well-managed farms in other districts

to see the methods which have brought success or failure there. In times like the present old methods must be reconsidered, new methods and suggestions studied and perhaps given a trial, and an open and inquiring mind must be joined with a determination to succeed.

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THE CO-OPERATIVE MARKETING OF FARM PRODUCE.

A conference on Agricultural Co-operation in the Empire, convened by the Horace Plunkett Foundation, was held at the British Empire Exhibition from 28th—31st July. The subject of the co-operative marketing of agricultural produce was discussed on 29th July, when a speech was made by the Hon. Charles A. Dunning, Prime Minister of Saskatchewan, of which the following is a slightly abridged report:—

I believe I am this morning to address myself to the subject of The Co-operative Marketing of Farm Produce, with particular reference to what is being done in Canada, and especially in Saskatchewan, the province from which I come. If, therefore, I appear to talk very much of Canada and Saskatchewan I trust the impression will not be conveyed that we think we are perfect along these lines in that part of the world. That is not the case, in fact one of the main objects of this Conference so far as I am concerned is to learn from others in different parts of the Empire what they are doing in connection with co-operative marketing of agricultural produce, in order that we may, if possible, perfect our methods in Western Canada.

In Canada Government assistance in co-operative marketing was primarily directed along legislative lines; the various provinces have from time to time enacted legislation facilitating the formation of co-operative organisations of farm producers for marketing in some cases specific products; in other cases generally. I think I may say that every province in Canada has legislation facilitating co-operative organisation for marketing purposes among farmers.

The outstanding features of such legislation are, first, cheap, easy incorporation; second, standardisation of methods, and third, the ensuring that the organisation when created shall remain co-operative in spirit, and not become an ordinary capitalistic corporation dominated by a majority financial interest. In these organisations the man, the producer, counts

rather than the investment of the producer in the capital of the organisation. I think I may say that this is characteristic of the forms of co-operative organisation in all of the various provinces of Canada.

Another form of State assistance that is present in some of the provinces of Canada, and to a very great extent at times in Saskatchewan, is assistance by way of State management. I know State management of co-operative marketing does not sound very good at first blush, but the manner in which it has been conducted up to the present time has been markedly successful in placing upon their feet co-operative organisations for the marketing of specific farm products, whereas in all probability if they had been left to tread the thorny road of ordinary experience themselves, the organisations would never have lived through it.

It is characteristic of the co-operative movement wherever we find it that the first class of individual in connection with it is what I might term the co-operative evangelist, the enthusiast who is imbued with the idea, who sees fully the possibilities and who can arouse his fellows to organise. Usually, however, the evangelist is not the type of man to look after the practical business of co-operation once the organisation is established, and our difficulty is that we do not throw up enough men who have that capability of evolving from the evangelist, from the enthusiast, into the practical man of everyday business who is absolutely necessary for the successful management of any business whether co-operative or otherwise.

The principle in Saskatchewan with regard to State management is this—we have in the Department of Agriculture a branch known as the Co-operation and Markets Branch. Its object is to respond to appeals from one district or another for information respecting co-operative marketing possibilities in connection with any product of the farm. I do not mean to imply that the State is endeavouring to force co-operative organisation upon the farmers, or that the State is a co-operative propagandist, but rather that in the Department of Agriculture is an organisation which can give expert advice to any group of farmers who are imbued with the desire of co-operatively marketing any product. The work has been very successful, but the problem speedily arose, especially in connection with what I call the subsidiary products of the farm, that the products were not of themselves of sufficient importance in the

general scheme of things to warrant an organisation being created to handle them especially. For this reason the method was evolved that the Co-operation and Markets Branch of the Department of Agriculture would undertake to market that particular product for these farmers co-operating for the purpose, not as a permanent undertaking, but on the distinct understanding that as soon as the product assumed a sufficient importance in the eyes of those producing it and was produced in sufficient volume to allow it to be done, a co-operative organisation entirely composed of the farmer-producers should undertake the work of marketing at first done by the Branch of the Department of Agriculture. Of course this evolution is not always easy. Whenever a branch of the public service undertakes this kind of business, the tendency of the civil servant is to desire to improve the reputation of his Department, and it is difficult to wean the institution away from the Department on that account. Another reason lies in the fact that it is human nature apparently to lean upon the Government as long as the Government will let you lean upon them. By starting right in connection with two products which have since assumed very great importance in our agricultural production those difficulties have been overcome.

Wool in Saskatchewan was a subsidiary product some years ago, not considered as of any great importance in the general scheme of things. The Co-operation and Markets Branch commenced marketing wool co-operatively for farmers, gradually wool production increased, gradually the benefits of co-operation with respect to the marketing of it became known, and now for some three or four years the wool of Saskatchewan is marketed through the Canadian Wool Growers Co-operative Association. Just as soon as the commodity reached a stage where it was good business to establish a co-operative managed by the farmers themselves who owned the wool to handle that commodity, that was done and it has gone forward from success to success. The same is true with respect to the dairy business in the province; before the province was formed, when it was a part of the North-West Territory, the Federal Government established co-operative creameries managed by the dairy branch of the Federal Department of Agriculture. When the province was formed the Provincial Government had to take over the baby. It was not a desirable thing apparently from the point of view of the relationship of the State to co-operation, but the industry was in the developing

stage—dairying was not then of great importance to the farmer, he was in it one year and out of it the next, he could not be persuaded to pay the business attention to dairying that he paid to his " money crop." The Government carried on the agreements for a number of years, and gradually by a process of education through the Dairy Branch of the Department, dairy production grew and about seven years ago the dairy farmers, said, " Now, we think we are ready to undertake the management of this enterprise ourselves "; and so the Saskatchewan Co-operative Creameries, Ltd., was formed (I will speak of the matter of financing a little later in another connection), and the farmers who produce the cream and who are the shareholders in the Saskatchewan Co-operative Creameries, manage their own business. They operate some 28 creameries and factories and have a very large business, also the dairy production of the province has increased enormously. There is another instance of co-operation in marketing a product being fostered in its infancy by a State Department, and later, on its attaining a stature sufficient to enable it to do so, being placed under the control of the producers themselves.

I do not know whether that experience is of any value to those from other parts of the Empire, but I may say that our experience leads us to the conclusion that we are prepared in Saskatchewan to continue the policy indefinitely. We are doing it now with potatoes. I do not know how long it will take before potatoes can be marketed co-operatively by an organisation of the farmers interested in growing potatoes, but I do know that judging by our previous experience it is the right line to take so far as our people are concerned.

Now, when I speak of State management I do not mean that the State is pap-feeding the industry by going into it. Every dollar of cost in connection with the State management of the co-operative marketing of a commodity in Saskatchewan is charged against the commodity; the producer must stand on his own feet in relation to the enterprise while the State is managing it in exactly the same way as he later must when he is handling it by a co-operative enterprise.

State Financial Assistance.—Now I come to State financial assistance, again a very delicate subject, because of that tendency of human nature to which I referred a little while ago. Personally, I know of nothing so deadening to co-operative effort as to have a fund

under the control of someone else from which you can draw to cover up and pay for the mistakes which you have made. I know of nothing so deadening to the up-building of co-operative organisations as the ability to get money from someone other than the co-operators, and it has been the ruin of many co-operative organisations. In connection with the creation of an organisation which requires to own and operate extensive facilities, the matter of providing capital for that purpose has always been a great problem to co-operators, because of the principle to which I referred a few moments ago, that the man counts and not his investment.

Co-operative Grain Selling.—In the early days in Western Canada we suffered a very great deal from what we called the grain monopoly. It was rather easy under the conditions prevailing there for a monopoly to be created; grain was handled in bulk through warehouses located only at the sidings of the railway companies, and naturally the organisation owning the facilities had a monopolistic opportunity which in those days at any rate was used to the fullest extent. Combination was easy to arrange because of the ownership of the warehouses, and naturally there were price agreements, grade agreements and all kinds of abuses. The farmers' organisations, especially the Saskatchewan Grain Growers Association, agitated with regard to this state of affairs, and it was decided to attempt to deal with the matter in Saskatchewan co-operatively on the general principle that if the farmers themselves owned the facilities, they would then dictate the manner in which their produce would be handled.

As a result the Saskatchewan Co-operative Elevator Company was formed for the purpose of dealing in grain. I was closely associated with the company from its inception, was in fact its first General Manager, and so I can speak with some confidence with regard to most of the important matters of principle connected with the organisation. First it was based upon central management with local advice with respect to local conditions. Each Local had a separate organisation for the purpose of representation at the annual meeting of the company. Each shareholder had one vote and no shareholder could hold more than 20 shares of a par value of 50 dollars, that is 1,000 dollars or £200 in English money, of the stock of the company. Each Local elected one of their number to represent them at the annual meeting, thus the number of delegates voting upon the matters at an annual meeting corre-

sponded with the number of locals of the company in existence. The transportation expenses and living allowance of the delegates to the annual meeting while away from home were paid by the company as a part of the cost of running the organisation, thus ensuring a full and interested attendance on the part of the representatives of the shareholders from all points in the province. At each annual meeting three directors are elected, to serve for three years, the full board thus consisting of nine directors.

The business of the company is to build elevators, operate them and generally engage in the business of grain marketing. Now, where does the Government come in? Elevators cost a great deal of money, and it was decided, after careful investigation, that provided the farmers in a locality subscribed sufficient of the capital stock of the company to cover the cost of the facilities which they required at their local point, and paid up in cash 15 per cent. of their subscriptions, the province should advance to the company the remaining 85 per cent. of the cost of erecting those facilities, taking as security a mortgage on the facilities themselves, and also a mortgage on the uncalled capital stock of the company. The relationship of the State to the institution, therefore, was that of first mortgagee on the facilities and first mortgagee on the uncalled capital liability of the individual shareholder. The repayment to the State was arranged on an amortised basis over 20 years with the understanding that the State would loan the money to the institution at a rate of interest not to exceed the cost of the money itself to the State, but the money has never been lent at a rate below the cost to the State, the idea being that there should be no contribution from the general taxpayer for the scheme, but rather that the credit of the province should be placed behind it, because of its vital importance to the welfare of all the people.

Well, that was done, and I will give some particulars of what has resulted. The shareholders now number 25,000. They have 425 country elevators, that means 425 local organisations of farmers, each of them grouped around the particular facility for handling their grain in which they are interested. The storage capacity of their country storage houses is 12 million bushels. In addition, as time went on, it was found necessary for the institution to own terminal elevators at the ports, to own appliances capable of treating damaged grain—hospital elevators, and they have at the present time over

$6\frac{1}{2}$ million bushels of capacity in terminal and hospital storage. In addition, last year they leased from the Canadian National Railway system owned by the Government of Canada, a large terminal elevator, I think the largest in Canada, of $7\frac{3}{4}$ million bushels capacity; so that they have at the head of the Lakes to-day 15,175,000 bushels of capacity for storing their grain, and out of a total capacity at the port of around 60 million bushels, 15 million bushels, or one quarter, is owned by the organised farmers, and operated by them.

You may ask about dividends, you want to know of course if the concern has been really co-operative. Well, in that regard, legislatively it may be, but as a fact the necessity of meeting the payments due to the Government from year to year, making provision for them, and making provision for the further extension of facilities at the ports, has prevented the payment of dividends. I want to show, however, that the industry as a whole is better off by reason of having the dividends kept in a lump and used to further the benefits of the institution by the creation of more facilities, than they would have been if the dividends had been distributed from year to year. The right, however, exists in the legislation for the institution to distribute profits co-operatively if and when it desires to do so; it is absolutely free in that regard. Up to the present, however, the necessity of developing further facilities has prevented any dividend. I might give some few figures showing what advantage has been gained.

The shareholders paid in 15 per cent. of the total subscribed capital of 4,422,000 dollars, about 700,000 dollars of actual cash, and the depreciated value of the assets of the institution is 6,647,000 dollars. Therefore, by the investment of their profits from time to time in further facilities and the repayment of indebtedness due to the Government, they have built up capital assets of 6,647,000 dollars from an initial cash investment of less than 700,000 dollars. The only creditor is the Government, and the amount unpaid, but not yet due, is about 2 million dollars. Since the inception of the institution in 1911 it has handled 335,000,000 bushels of grain, and this present season over 50,000,000 bushels of the Saskatchewan crop will pass through the co-operative system.

What has been the effect upon the industry? Has it been good? That is the most difficult thing to prove, the benefits to the individual in dollars and cents of co-operative marketing; if a co-operative raises its price to the producer

because the market warrants it, the competitor does the same; that is natural, that is business, and then of course he says to the co-operator, "Now, what good is this institution to you, I am paying the same price," but of course it is difficult to find out what he would be paying if the co-operative were not there. In the early days of the Institution it was possible to demonstrate this on some occasions, because we had only a few elevators to start with, and we were able to compare the prices being paid by our competitors at the points at which we had elevators and the prices paid by them at other points where we had not elevators, so in the early days it was fully possible to demonstrate the actual gain to the farmer. As the system extended and became represented at most points in the province naturally traders saw to it that this weapon was taken out of our hands. If our price list in the province of Saskatchewan generally is at a certain figure, one can rely upon it that the others will not be very far away. However, the farmers generally seem to be able to understand that the co-operative really compels the private trader to pay fair prices.

In regard to the relationship of the State, may I say this, that in 13 years the company has met religiously every dollar of its obligation to the province. A Government guarantee of credit was necessary in the earlier years, because of course the Government held all the security, there was no security to give to the bank except the commodity itself, and, of course, a margin was required. In those years a Government guarantee was given; for the last five years the concern has been able to get a larger credit than any grain concern in the Canadian grain business without one dollar of Government guarantee.

Dairy Co-operation.—Naturally, the success of that plan in relation to grain led us to consider the application of the same general principle with respect to other commodities, so when the creameries were turned over from State management to the management of a co-operative concern, it was organised on the same general principle as the Saskatchewan Co-operative Elevator Company. Thus, we have to-day the Saskatchewan Co-operative Creameries, Ltd., operating on the same general principle. I cannot point to the same record of unbroken success in regard to the creameries, but I am more hopeful about them now. Whatever difficulties have occurred were difficulties connected largely with the deflation in values of

dairy products during the years immediately following the War. I suppose there are many here who have experience in handling dairy products at a time when the slump came—I do not know if there was a slump in this country, but we had an awful one. While the creameries have been passing through a difficult time there is every reason to hope that their success from this time onward will be, as it was during the few years following its inception, equal to the success shown by the grain institution in relation to its business. One must remember that it is much easier to interest the farmers in co-operation in grain marketing in Saskatchewan than it is to interest them in dairying co-operation. Grain is the money crop, dairying is just getting into its stride, but more and more every year farmers are interesting themselves in dairying, and there is, I feel sure, a bright future for the application of the co-operative principle to it.

Co-operative Live Stock Markets.—Another form of State financial assistance which may not commend itself to you, but which I give for what it is worth, is in connection with co-operative stockyards. The producers of cattle for beef purposes complained bitterly for many years at the conditions prevailing in stockyards which did exist, and also of the very meagre stockyard provision which was made by the railway companies and those interested in the trade. The problem was a very real one, and finally an attempt was made to solve it by the formation of two co-operative organisations to control stockyards, one in the northern part of the province, and one in the south. Study of the subject showed very plainly that it was not possible, or at least was not likely, that co-operative stockyards could be profit-making institutions if they fulfilled the function of providing proper facilities with full liberty to farmers to use them. So it was decided in that case that if the farmers would themselves organise a co-operative stockyard, put their money into it on the same general principle as the others, that the State would in that case, not make a loan because of the little prospect of its repayment, but would make an outright grant of one-third of the cost of providing the facilities, because of the peculiar nature of the business. Here I would like to point out that one cannot adopt any general principle which applies to one commodity and, *ipso facto*, it will apply to all. It will not. Each commodity requires to be studied separately. The farmer is always the same in his beautiful diversity, you have always the same human materials to deal with. I have no hesitation in stating

that if we had made a loan to co-operative stockyards instead of a grant, no interest would ever have been paid on it, and the principal would never have been repaid, but the value of these co-operative stockyards to the stock industry cannot be over-estimated, because they provide a free market under the control of the producers themselves for the handling of their stock.

Advantages and Disadvantages of State Financial Help.—I referred to the advantages and disadvantages of help being given by way of State management. Now I want to refer to the advantages and disadvantages as we see them of State financial help. There are no disadvantages so long as there is no trouble, but the moment trouble arises, as was the case with our co-operative creamery enterprise when it lost money, naturally, they all said, "What is the Government going to do about it?" There is the disadvantage of Government assistance—unless your Government possesses a stiffer neck collectively than most politicians do it is possible for very great political pressure to be brought to bear for the State to assume part of the financial burden brought about by something which the co-operative institution itself was wholly responsible for. I think the Co-operative Creameries shareholders in Saskatchewan will agree to-day that the refusal of the Government to hand out money to the institution, but just merely to stand by, was the best thing that could have happened to them at the time when they were facing such difficulties. I feel as certain to-day as I felt then that to have spoon-fed that institution during the crisis would have meant its death ultimately.

Co-operative Wheat Pool.—There is now in Western Canada a new development in co-operation about which you will hear probably a great deal in the near future, and in concluding my remarks, I want to give you some information about it. In spite of all the progress that has been made in co-operative work the farmers have not been fully satisfied with the application of the principle because it rested upon the same general idea as the consumers' co-operative organisation rests upon in this country; that is to say, in the control and sale of the product by the co-operative society and the return by the society to the individual of the market price of his product at the time of individual sale and also of dividends. They have not been satisfied very largely because of the fundamental conditions prevailing. I think you all agree that because of the position of

agriculture we are the last to feel the benefits, if benefits there be, of inflation and the first to feel the disasters of deflation. Consequently the price of everything we produce, and I think I can speak for the agriculturists of the whole world when I say this, has gone down practically to pre-war levels, and in some cases below, while the prices of everything of which we are consumers, including labour, remain considerably above pre-war prices. Labour is organised to-day to get a living wage; capital is organised to secure a return upon the capital invested. The farmer is the one man in all creation who when he buys says, "What is the price?" and when he sells asks exactly the same question. Other industries when they buy have something to say regarding the price, and certainly when they sell have a very great deal to say about it. Our farmers in Western Canada have become impressed with that, I might almost say obsessed with it, during the past few years, and they say briefly this: our present co-operative organisations do not change that situation, the only difference being that instead of the individual farmer going to market and saying: What is the price? the society goes to market and says, What is the price? So the farmer has been saying, somehow we must change that. The farmer must in some manner in the sale of his products have the advantage of mass selling which is enjoyed by every other industry, and he must attain that advantage co-operatively.

In Saskatchewan there are 100,000 sellers of wheat under our present system. Over in England here and in France I learn that the buyers of wheat for milling purposes are more and more getting together. I do not understand how it is possible for the world to imagine that the price of everything that is produced should go up, the price for a man's labour, for his capital, but side by side with that condition you can establish the principle that the price of food shall not go up. I cannot for the life of me understand it. There is a powerful regulator against unreasonable combination by farmers, and what is that regulator? The vacant spaces of the world which can be brought under cultivation provided the venture is profitable. There is a safer regulator in the farming industry than there is in any other industry in the world; political regulation is required for industry generally; for labour, laws are required; but the natural economic law rules the farmer; if his industry becomes more profitable more men come into it, and there is a lot of land in the world which can be put under crop. Of course we have the same tendencies as other people. We will get as much as we

can for what we produce, power is no safer in our hands than it is in the hands of any others when it is a power which is almost monopolistic. But fortunately there is a check upon it which does not exist in connection with any other industry that I know of. So there has been evolved the pooling co-operative method of marketing wheat. To English co-operators it will sound drastic, and you will wonder why men would submit themselves to the harshness of the provisions. I will tell you the reason. You cannot go on year after year losing money on your farm and getting deeper into debt, there is only one end to that—your mortgagee will put you off. So half the farmers of Saskatchewan, more than half the farmers of Alberta and nearly half the farmers of Manitoba have banded themselves together in what is called the Co-operative Wheat Producers, Ltd., for the purpose of marketing their wheat: they are not touching any other grain just at present, just wheat. They bind themselves in an iron-clad contract to turn over to the pool every bushel of wheat they produce for sale for the next five years. There is nothing in the contract regarding what the pool will pay them for it; that cannot be determined. The pool composed of themselves merely agrees in the contract to make an initial payment when the wheat is delivered, to sell all the wheat of all the farmers to the best advantage, and then to return to those producing it pro rata any balance remaining on hand over and above the initial payment.

That briefly is the scheme. As to the merits of it only time can demonstrate. I am not disposed to criticise it, because it is a bona fide attempt to solve a very real problem through the medium of mass selling and averaging of the price returned. The relationship of the State to it is very slight indeed: one of the principles upon which it is based is that there shall be no politics about it.

In Alberta the wheat pool has been operating for one year. In Saskatchewan it comes into operation this year, and in Manitoba also; so that this year for the first time more than one-half of the wheat produced in the three provinces of Western Canada will be controlled so far as the selling of it is concerned by an organisation of the producers themselves.

Consumers here say: "Will it put the price of bread up?" Maybe it will, but nobody consulted the farmer when they put up the cost of everything that enters into the cost of wheat production. I do not know why it should be an axiom that the price of everything a farmer produces must be kept down while

the price of everything that everybody else produces must go up; I cannot understand why that should be an axiom in this old land and everywhere else. Everywhere I go they tell me, "Oh, but that will increase the price of food." Well, everybody who is eating that food which the farmer produces is getting more as the reward of his labour than he did get a few years ago, why should the farmer be the only man who is not to share in the general rise in the value of commodities. I do not know much of economics, but that strikes me as a most ridiculous proposition.

I spoke of the State relationship to the new pooling organisation in Saskatchewan. It passed over the province like a wave, the farmers joined it by the thousand, there are over 50,000 of them tied up by an iron-clad contract for five years agreeing that to the extent to which they break that contract by marketing any of their grain elsewhere, they will forfeit 25 cents a bushel by way of liquidated damages; that is pretty stringent, but they mean it. In order to secure the necessary 50 per cent. of acreage which the promoters of the pool believe to be necessary in order to guarantee the success of the scheme, it was found they would require funds to complete the organisation, and of course they came to the Government. I suppose that is one of the disadvantages of the head of the Government being a known co-operator. The Government considered the matter and decided that it would not be a sound principle to give this co-operative organisation any money, but we did decide also that when it was so near completion, the lack of a few thousand dollars could not in the general public interest be allowed to stand in the way of the completion of the experiment, so a loan was made, I think about 30,000 dollars, to assist in completing the organisation in order that the experiment might be carried out. The loan is a first charge upon the wheat handled by the pool when it starts to function; that is the only State assistance given by the province in connection with the new pooling method. I think it will work successfully, provided the farmers can throw up from among themselves the kind of brains that can handle it. It will be the biggest concern of its kind that has ever existed in the world, it will control more grain than ever has been controlled by a single organisation, and that organisation is altogether a producers' organisation, returning no interest on capital and financing purely on the commodity itself. There will be no difficulty at all about it getting credit, because the initial payment is of course always below the present market value of the grain. We are looking forward to a considerable development along co-operative pooling lines.

WIRE FENCING FOR GRASSLAND.

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FARMERS are putting down a good deal of land to grass, and in connection therewith are confronted with various problems, of which fencing the areas is one of the most pressing. There is no doubt that wire fencing is the cheapest and most effective way of controlling stock on pasture land.

Posts.—These are best made of wood; and of the various kinds of timber, larch is undoubtedly the cheapest and among the most durable. If larch thinnings can be obtained they make excellent posts and should be cut 5 ft. long and be of a minimum diameter at the small end of 3 in. Spanish chestnut poles are also thoroughly suitable and may often be purchased in 10 ft. or 15 ft. lengths at the price of 1d. or less per foot run, and they may be cut up into suitable posts. Posts should not cost more than 6d. each. The two kinds of timber indicated may be used in their natural condition and will have a life of about ten years, depending on the class of soil and the quality of the timber. Other wood that is suitable is ash, sycamore, birch, Scots fir, and spruce, but these woods in their natural condition have a very short life and should be creosoted before being used. A simple creosote tank would be one about 5 ft. long, 2 ft. wide, and 3 ft. deep, and if the posts after being pointed are placed with their lower ends in this tank and kept in creosote for a fortnight their life is greatly increased.

The posts should be placed at intervals of about 12 ft., if the ground is fairly level and if the fence runs straight, but on undulating ground and with a crooked fence the interspacing must be closer. The straining posts should be 7 ft. long and should go into the ground about 3½ ft., with a diameter of about 6 in. at the small end. The success of the fence depends very largely on the way in which the straining posts are inserted, because if they are not thoroughly firm the wire soon becomes slack.

Any straining post can be fixed immovably in a hole 4 ft. deep, and, in fact, if it is difficult to get the post deeper than 3½ ft. this depth will prove sufficient provided a little extra care is given to the details of fixing.

Every straining post should have an "anchor" fixed near its base. This consists of a piece of sound wood about 3 ft.

long and 3 in. or so in thickness, which may be round or squared: on the whole it is better squared. With the saw a notch about 2 in. deep is cut within 3 in. of the base of the post, the piece of wood taken out being of such a width that the anchor fits exactly into the slot, so that when it is driven home it is firmly held. To make all secure a long nail may be driven through the anchor to hold it immovably in position. It does not at all matter whether the anchor or cross piece projects equally on each side of the post or whether the whole of it projects from one side. The hole in the ground to receive the post should be about 3½ ft. long and 12 in. to 15 in. wide, according to the size of the post, but there is no need to throw out more soil than is sufficient to allow the post to be easily inserted. If the end of the fence comes close up against another fence running at right angles, or against a wall or building, the trench for the insertion of the post should lie in the direction of the line of the fence, because only in this way can the terminal post be placed close to the pre-existing fence, building, or wall. If, on the other hand, the end of the fence is a gateway, the trench to receive the post had better be at right angles to the line of the fence; the anchor will then project equally on both sides of the post.

Having dug the hole and ascertained that it is approximately of the right depth, the post with its anchor attached is carefully dropped into the hole, with its centre exactly in the line of the fence. This having been done, a few spadefuls of soil are thrown in and carefully rammed round the foot of the post and along the side of the anchor. In order to get the soil into all the corners and angles of the hole the rammer should not be more than 2½ in. in diameter, and if the post so fills the hole that there is not more than 1 in. or 2 in. of clear space between the sides of the post and the sides of the hole, the rammer for use in packing that part of the hole should not be more than 1 in. in thickness, a piece of wooden rail 3 in. × 1 in. being useful for the purpose.

Having satisfied oneself that the position of the post is right, more soil is filled into the hole, one man shovelling while another confines himself to packing and ramming, sufficient time being given for the latter to do his work thoroughly. The secure fixing of the post is very largely a matter of thorough packing of the soil, and if a few stones 2 in. to 3 in. in diameter are available they should occasionally be thrown on the soil

close to the post and be beaten in. After the filling of the trench has proceeded to the depth of about 1 ft. or so, it is necessary to see once more that the post is perfectly perpendicular, because later it is impossible to rectify a mistake of this kind.

The trench having been filled and thoroughly rammed, the next thing to do is to fix the stay. If the post is a terminal one a single stay is, of course, all that is necessary. Even where the post is an angle one, that is to say, where the line of fence makes a right angle, more or less, at the post, some workmen, by way of economising, put in a single stay, so as to bisect the angle, but such a practice is not to be recommended, because the stay projects into the field and may possibly trip up stock. It is much better to insert two stays at an angle post, each of which will lie along the line of its respective fence. The stays must be sufficiently thick and strong to obviate any chance of bending when the pull of the fence is brought to bear upon them; but a stay 4 in. thick at the butt and 3 in. thick at the other end will suffice if it is of larch, oak, or Spanish chestnut.

A notch 1 to 1½ in. deep is cut with a chisel rather to one side of the median line of the post, and about 2 in. below the point where the top wire will come. This having been done, and the end of the stay having been prepared so as to fit accurately into the notch, the other end is put on the ground at approximately the spot where it will ultimately be fixed. A bevelled hole about 15 in. deep is now made in the ground with a spade, and it is a good plan to make an allowance for a big stone or rough block of wood, say 15 in. long and 6 in. in section, to be placed transversely at the end of the stay, and about 6 in. below the surface of the ground. A little "humouring" will be necessary in order to get the supporting block or stone into its proper position, but the great thing is to see that the position is rather too near than too far from the straining post, because if it is too near it is easy to dig out a little more soil and let the block go back a trifle; and, finally, by using the stay as a battering ram it can be beaten tight against the undisturbed back of soil, and the other end of the stay can be accurately let into the notch in the straining post.

The intermediate posts are pointed and driven about 20 in. into the ground with an iron mell.

Wire.—For protection against horses and heavy cattle the wire must be stouter than for sheep and young horned stock. For the heaviest class of stock the top wire may be No. 4 gauge with five wires below of No. 6 gauge, which is quite sufficient. For lighter stock and sheep the top wire may be No. 6 gauge and the other wires of No. 8 gauge: for all practical purposes this makes an excellent fence. The interspacing of the wires should be about 10 in. between the top pair, then 8 in., 7 in. and 6 in. below. There is no doubt that solid galvanized wire is the best to use and costs at the present time about 18s. 6d. a cwt. Stretching of the wire may be done by any reliable machine, of which one of the best is the winch, called in Scotland a Monkey.

The distance between the strainers will depend upon the ground, but it is not usually necessary to have these less than 300 yds. apart, in fact one gets a tighter fence by wide interspacing than by having the terminals too close together.

The complete outfit of fencing tools would consist of a mell, costing about 15s.; a borer, 4 ft. long, of malleable iron, weighing about 14 lb., the price of which is about 5s.; a "Monkey," which will cost about 20s.; and 2 conical malleable iron pins, 12 in. long, to drive into the post to hold the wire tight after it has been stretched, costing about 1s. each. A holder for knotting the wire is also convenient, the price of which is about 2s. These, with a claw hammer, a chisel, a file, and an auger for boring the holes, complete the equipment. At present prices the total cost per yard should not exceed 1s.

While a wire fence is undoubtedly the cheapest and most effective form of fence, other kinds of fence, for instance, posts and rail may be used, but the cost of this is very much more than the wire fence. Sheep netting may be also employed for enclosing an area, but this is more expensive than wire and is much less effective.

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APPLE AND PEAR SCAB.

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The Apple Scab Fungus (*Venturia inaequalis*).—In the Ministry's leaflet No. 131, on Apple and Pear Scab, the statement occurs: "As it is from diseased shoots that the scab starts afresh each year, it is worth making a determined

effort to attack the fungus in this position and also to prevent it from infecting the wood in future seasons." This statement accurately represented up to the present year our knowledge as to the manner in which, in this country, the fungus causing apple scab or black spot lives on through the winter to the succeeding summer. While it remains true that the scabbed young wood of certain varieties of apples,* which is shown in Fig. 1, is undoubtedly a prolific source of infection, we have now to record the existence in England of the true winter-stage of the apple scab fungus—a stage well known in most, if not all, of the apple-growing countries of the world, but hitherto unreported for this country.

In February last, on visiting an orchard near Maidstone planted with Bramley's Seedling and Newton Wonder trees, we observed numbers of the previous season's leaves lying on the grass. That season (1923) the trees had been severely infested with scab, both on the leaves and fruit, and most of the leaves found in February showed evident spots where the scab had been present during the previous season. These leaves were brought into the laboratory and kept damp. After a week or so fruit bodies of a fungus were seen to be developing, and on the thirtieth day after being brought into the laboratory these were ripe and ejecting their winter-spores.

The general appearance of the fungus at this stage is as follows: the apple leaves show, scattered over their whole surface (irrespective of the distribution of the scab spots formed in the previous season), minute dark brown or black pimple-like bodies (*perithecia*) which have broken through the skin of the leaf, often on both surfaces. These bodies are just visible to the naked eye and are best seen when the leaf is damp. A photograph of two fragments of a leaf (magnified six times) bearing numbers of these bodies, is reproduced in Fig. 2. With a pocket lens the minute projecting necks can often be distinguished. If a section of a dead apple leaf is cut and examined in water under the microscope, the structure of these spore-containing fruit-bodies can be observed (see Fig. 3). The fruit-body (*perithecium*) is flask-shaped, with a projecting neck, and is filled with a large number of little sacs (*asci*), each of which contains eight two-celled winter-spores (*ascospores*) (Figs. 4 and 5). As soon as the perithecium is mature and

* Leaflet 131 may be profitably consulted by the fruit-grower on the subject of apple scab and its control. Full information is given on such important practical points as the most susceptible varieties, as regards fruit and young wood, as well as the best fungicides to use to control the disease.

obtains sufficient moisture, the winter-spores are ejected from the little sacs and forcibly expelled through the mouth of the perithecium into the air. The late Dr. R. Aderhold, a German mycologist, whose investigations* have thrown so much light on the life-histories of the apple and pear scab fungi, found that the apple scab fungus throws out its winter-spores into the air to a distance of $1\frac{1}{2}$ cm. ($\frac{3}{5}$ in.).

A search was then made in apple plantations in other parts of Kent, and dead apple leaves bearing ripe perithecia were found in abundance at Wye, and at Egerton, near Ashford. The fungus above described was recognised as that called *Venturia inaequalis* on the Continent and in America. Many workers abroad have carried out experiments which have proved it to be the winter-stage of the apple scab fungus, which in its summer stage (*Fusicladium dendriticum*) is the cause of the "scab" or "black spot" of the apple and the sooty blotches on apple leaves. This winter-stage on dead apple leaves has not hitherto been found in English fruit plantations, nor been proved in this country to be connected with the apple scab disease.† The experiments described below establish definitely the connection between the two.

In the first experiment, winter-spores were caught in drops of water placed on slips of glass suspended over dead apple leaves bearing mature fruit-bodies (*perithecia*). The winter-spores germinated at once, and by the second day bore long germ-tubes.

In one instance sporelings, after being occasionally deprived of moisture and then wetted again—a process which, as Dr. Aderhold has noted, is favourable to the initial stages of development of this fungus—were provided with a few drops of apple-leaf extract. Growth continued, organs of anchorage (*appressoria*) were developed and by the sixteenth day after germination there were produced the well-known summer-spores (*conidia*) of the apple scab fungus.

In the other experiments, living apple leaves were inoculated with winter-spores obtained from dead apple leaves. In one

*R. Aderhold; Die Fusicladien unserer Obstbäume (*Landwirtsch. Jahrb.*, XXV, 875 (1896).)

† In articles in the "Gardeners' Chronicle" (April and May, 1924) we have pointed out that as long ago as 1866 Cooke (in *Journ. of Bot.*, IV, p. 248) described this fungus on dead apple-leaves as "*Sphaerella inaequalis*," and we have seen, in the Kew Herbarium, a specimen collected by him at Henlow, Beds., April, 1866. It was not known at that time that the fungus in question was connected with the apple scab fungus (*Fusicladium dendriticum*) and this old record of what has since been recognised as the winter-stage of the fungus has remained completely forgotten for 58 years.

case pot plants of French Paradise were used, kindly supplied to us by Mr. R. G. Hatton. Twenty-two leaves were inoculated, on 28th April, in the following manner :—

Ripe fruit-bodies of the fungus were picked out with a needle from a dead apple leaf and allowed to discharge winter-spores into distilled water in a watch glass. Subsequently a little of this water (which contained many thousands of the spores which had been discharged) was drawn up in a fine glass tube and blown out again, with the spores, on to the upper surface of the apple leaf. All the leaves, including those inoculated, were kept moist from day to day by atomising them with water. Some of the inoculated leaves were kept for 15 days in glass chimneys with plugs of cotton wool at the outlet (for 10 days), while others were freely exposed to the air. On 6th May (8 days after inoculation) many of the leaves showed pale, translucent spots, and on 13th May (15 days after inoculation) characteristic dark spots of scab appeared, which on microscopic examination were found to be bearing an abundance of the summer-spores—the so-called *Fusicladium* stage. All the control leaves remained quite free from scab.

The total number of apple leaves inoculated in our experiments was 22 and the number which became infected was 13, *i.e.*, 59 per cent. In Dr. Aderhold's experiments the percentage of successful infections was about 33. A similar successful experiment was carried out on the leaves of a commercial variety of apple in the open.

We have observed at Wye the ejection of winter-spores from dead apple leaves under the following conditions. On 27th April some freshly collected dead apple leaves, bearing the fruit-bodies, were kept damp on wet blotting paper in glass dishes. A small slip of glass, previously moistened on the lower surface, was suspended a short distance above each leaf. Within a short time, winter-spores had been shot up by the fungus into the minute drops on the moistened surface. In one experiment leaves placed in the open at 4.30 p.m. were found, by 9.10 p.m., to have ejected hundreds of spores, the temperature varying between 45° and 46° F. during the period. Just previous to the ejection of the spores, the sac undergoes a *rapid* and practically instantaneous elongation, to approximately twice its original length. The spores are then discharged in quick succession, like bullets from a machine-gun, and the sac then contracts. It is clear, therefore, that during cold, wet periods in April and May,* such as were experienced last spring, the

* We observed ripe ascospores as early as 7th March.

apple scab fungus on dead apple leaves on the ground is discharging spores into the air; these spores, carried to the young apple leaves, infect them and give rise to the well-known dark, sooty patches of scab. On the living apple leaves the fungus increases rapidly, producing multitudes of summer-spores. These, carried by wind and rain, infest the fruit, and produce the "black spot" or "scab," a disease unfortunately so characteristic of much of the apple crop grown in this country.

Economic Importance of the Occurrence of the Winter Stage of the Apple Scab Fungus.—It is probable that the occurrence of a winter stage in the life history of the fungus in this country has a very direct bearing on the *early outbreaks* of apple scab in our orchards and plantations. It is no uncommon occurrence for severe infestations of scab to take place season after season on varieties of apples which show none, or but little, of the disease on their young wood. One case which has lately come to our notice may be instanced here.

In connection with some spraying experiments we inspected rows of the Bismarck variety in a plantation at Egerton, near Ashford, in the spring of 1923, at the time when the trees were just out of flower. At this early date the trees were already somewhat severely infested with scab, patches of which occurred on many of the oldest leaves surrounding the flower-trusses. A close inspection was made of the young wood, which was found to be free from scab with the exception of one or two pustules on a very few trees. This early outbreak on the Bismarcks remained inexplicable, since at that time the occurrence in this country of the winter stage of the apple scab fungus had not been observed; it was conjectured at the time that some rows of Cox's Orange Pippin, which stood some 50 yards away, and whose wood was badly scabbed, had been instrumental in causing the outbreak.

This season (1924) a similar early and severe outbreak on the Bismarcks was noticed; on 1st May, before the trees were in flower, a leaf here and there round the flower-trusses could be found with a spot of scab, usually on the under-surface of the leaf. By 21st May, when still in flower, these three rows of Bismarck (22-30 trees in the row) showed, on nearly every tree, a number of the leaves round the flower-trusses, with well-established spots of scab, bearing abundant summer-spores. As in this plantation (notwithstanding the fact that pigs had been turned in) it was not difficult during

April and May to find on the ground remains of the previous season's dead apple leaves bearing ripe fruit-bodies discharging winter-spores, there seems little doubt now that the early outbreak of scab in this case—as in many others—is to be attributed to infection arising from the ground.

Control of Apple Scab.—It is clear from the observations recorded above that a prolific source of infection may exist in the spring in the dead scabbed leaves of the previous season. To some extent close grazing by sheep in the orchard, and careful folding of the plantation with pigs will tend to the destruction of the dead apple leaves, although, where these have been plentiful, it is to be feared that enough material* will be left to start early outbreaks of scab. In gardens, and possibly also where choice varieties of apples are grown on an intensive system, as on cordons, it may be found practicable to sweep up and burn the leaves from diseased trees in the autumn. Whether the formation of the winter stage of the fungus takes place every winter in this country, or only in those winters (such as the last) characterised by dry cold weather, can be determined only by future observations. It is possible that in wet, mild winters the apple leaves decay before the fungus can produce its fruit-bodies.

There can be little doubt, however, that for the commercial fruit grower the best practice is to prevent the formation of the winter stage of the scab fungus, rather than attempt to destroy it when it has occurred. Two or three careful sprayings in spring and early summer will prevent the leaves on the tree from becoming infested with scab, and thereby remove any possibility of their becoming a source of infection in the following spring. The same operation will also prevent the production of scabbed young wood, the other possible source of infection in the spring.

On some varieties of apples—*e.g.*, Cox's Orange Pippin, Worcester, Bismarck—the first spraying of the leaves (where the trees have borne a scabbed crop in the previous season) must be given *just before* the trees flower, *i.e.*, when the flower-buds are showing pink but have not yet opened. This spraying will prevent early attacks of scab on the first produced leaves round the flower-trusses. Another important time for spraying is when the petals have just fallen. This is undoubtedly the most important of all the sprayings, and must

* Wallace, an American mycologist, has computed (Cornell Univ. Agric. Exper. Station. Bull. 335 (1913)) that from a fragment of leaf 1 cm. square, 5,630 winter-spores may be discharged in 45 minutes.

never be omitted on trees liable to scab. At this date the majority of the young leaves will be protected by the fungicide used. In many cases another spraying, three weeks or a month later, will be found profitable.

The best spray fluids* for the purpose are Bordeaux mixture (using the excess lime Bordeaux where scorching of the leaves or russetting of the fruit is likely), or lime-sulphur (on those varieties liable to injury by Bordeaux mixture). A third spray fluid, viz., lime-sulphur mixed with arsenate of lead (1 gal. lime-sulphur to 29 gal. water, and 4 lb. arsenate of lead paste to the 100 gal. of spray fluid) gave very good results in some experiments carried out in 1923. These experiments are being repeated this year, and the detailed results obtained in the two seasons will be published later.

The Pear Scab Fungus (*Venturia pirina*).†—After the discovery (noted above) of the winter-stage of the apple scab fungus on dead apple leaves, a search was made for the similar stage of the pear scab fungus on dead pear leaves. This was found during March, 1924, at Wye, Kent, on dead pear leaves collected by the wind at the foot of a hawthorn hedge, close to pear trees which had borne scabbed fruit for a number of seasons.

The fruit-bodies (*perithecia*) of the fungus are just visible to the naked eye as minute dark coloured points scattered, or thinly grouped, over either or both of the surfaces of the leaf. Within the fruit-body (see Fig. 6) are large numbers of little sacs (*asci*), each containing eight two-celled winter-spores (*ascospores*) (see Figs. 7 and 8). When the fruit-bodies are ripe, the winter-spores are forcibly discharged in quick succession from the mouth of the neck. On 28th April, freshly collected dead pear leaves bearing the fungus were, after being wetted, placed out of doors and it was found that the fruit-bodies continued to eject hundreds of winter-spores during the day. The weather at that time was dull, with occasional sunshine and a cold wind; the temperature varied from 49° F. to 55° F.

It seems possible that the development of winter-spores of the pear scab fungus on dead pear leaves takes places commonly in this country, but has been generally overlooked. Dead pear leaves obtained last March from near Barnstaple,

* The formulæ for these will be found in the Leaflet No. 131, on Apple and Pear Scab, issued by the Ministry.

† A technical description of the fungus has already been given in the "Gardener's Chronicle," 10th May, 1924.

North Devon, were producing this stage in abundance. On the Continent of Europe, and also in the United States, the winter stage of pear scab is of common occurrence; in Germany (Silesia), according to the statement of the late Professor Aderhold, it is the exception to find dead pear leaves free from this stage of the pear scab fungus.

It can be considered as certain that wherever the fungus has developed its fruit-bodies in the dead pear leaves the winter-spores are discharged from these in vast numbers all through the spring months, from April on into June. These winter-spores, carried by currents of air to the young pear leaves or fruit, infect them at once and produce the well-known velvety spots of scab.

Hitherto in this country that stage of the pear scab fungus which occurs on the young wood (one- and two-year-old shoots) of the pear tree has been the only one known which carries the disease over from one season to the next. Now that a further stage in the life history of the fungus has been found in this country, we can lay down certain rules as regards the best methods of controlling pear scab.

In gardens, as well as in certain special cases in the commercial plantation, it may be advisable to collect and burn the scabbed leaves when they have fallen in the autumn or to dig them well into the ground. If the dead leaves are converted into leaf-mould, this should not be used on ground near pear trees until it is old and well rotted. For pear growers on a commercial scale, however, the main safeguard against attacks of pear scab lies in spraying the leaves while healthy, and so preventing them from becoming scabbed and from becoming later, when fallen to the ground, the home of the winter-spores of the fungus.

Directly the blossom is set (or, better, while a few flowers still remain open) spray the tree thoroughly with Bordeaux mixture, using a fine, misty spray and taking care to wet the under surfaces of the leaves. Repeat the spraying with Bordeaux mixture three weeks later. These early sprayings are essential for the control of pear scab; they prevent the fungus from infecting the leaves and producing there immense numbers of spores, which in showery weather, passing to the young pears, make them scabby and often cause them to crack. Bordeaux mixture is, in our experience, the best fungicide to use against pear scab; it is quite harmless to the foliage of any variety of pear, whereas lime-sulphur is not so strong a

fungicide and when used on some varieties, *e.g.*, William's Bon Chrêtien, may injure the foliage. Two good sprayings of Bordeaux mixture applied early, usually suffice to keep down the scab disease on pears; where the trees have been neglected for several seasons, however, a third spraying with Bordeaux mixture three weeks after the second, should be given. As a rule, winter spraying against pear scab is useless; where, however, an appreciable amount of scabbed wood exists in the tree, a spraying in March with lime-sulphur at winter strength (1 gal. of the concentrate (1·30 sp. gr.) to 14 gal. water) will do good. As much as possible of the scabbed wood should be cut out in pruning. The fact should not be lost sight of that the summer spraying of the leaves with Bordeaux mixture, as described above, will protect the young wood, as it develops, from scab infection.

The two known sources of infection in the spring would then be eliminated, viz., the scabbed wood with its spores and the dead scabbed pear leaves with their winter-spores.

One other point of practical importance deserves to be noted. Investigations have shown that the spores of the pear scab fungus require a drop of moisture (rain or dew) in order to be able to germinate, and, in accordance with this fact, many observers have noticed that espalier-grown pears protected from direct rain suffer less from scab. In special cases, as in the growing of valuable dessert pears, it might be practicable to provide protection from the rain; or to adopt another method, recommended in France for use in the growing of the choicest pears ("les fruits de luxe"), viz., to tie on paper bags over the young healthy pears to preserve them from becoming infected later in their growth.

Summary.—Recent observations have shown that in this country also, as in the other fruit-growing countries, the apple and pear scab fungi develop a winter stage in the dead "scabbed" leaves after these have fallen to the ground, and that the winter-spores there produced are expelled in the spring and infect the young leaves and fruit, producing the well-known "scab" disease.

The discovery of this stage makes the spraying of apple and pear trees all the more necessary, in order to protect not only the fruit of the current season but also to prevent the fungus from growing on the leaves, and when these have fallen to the ground developing winter-spores which will restart the disease early the next season.

LIVESTOCK IMPROVEMENT IN ENGLAND AND WALES IN 1923-4.

THE reasons for the introduction of the Livestock Improvement Scheme in 1914, its object and the lines on which it operates have been set out so fully and often in the *Journal* and elsewhere as to need but brief recapitulation here.

At the outset it was realised that the funds available for the purposes of the scheme in England and Wales precluded any ambitious attempt at the direct provision by the Government of high-class sires required for use in the grading up of inferior farm stock, even had this been practicable or advisable.

The scheme was, therefore, framed more as an educational measure with the object of showing, by practical demonstration throughout the country, the importance and value of care in the selection and use of good pedigree sires and the direct gain resulting from the application of knowledge obtained from taking milk records and managing dairy herds in a more systematic and economic manner.

For these purposes annual grants are made to bull, boar and heavy horse societies which undertake the provision of approved pure-bred sires for the use of their members and to milk recording societies operating under the scheme.

That the objects aimed at are being achieved is indicated by the annual increase in the number of sires subsidised and the growing interest in and development of the milk recording movement as shown in the tables herewith.

Apart from the direct benefit accruing to the agriculture of the country by reason of the grading up of inferior stock through the instrumentality of the scheme—the focussing of attention on livestock improvement and the association of the Ministry's Livestock Officers with farmers and small holders in their several districts has had some influence, though indirect, in stimulating interest in breeding, in increasing the number of breeders and users of pure-bred cattle and pigs, and in creating a bigger demand for suitable sires amongst people not directly concerned with the scheme.

Bulls.—The total number of bulls actually located for service during the year ended 31st March, 1924 (*i.e.*, continued from previous years with renewed grants or provided for fresh districts during the year), was 978, an increase of 31 on the preceding year.

BULL SCHEME.

(Showing the number of Bulls subsidised during the past 10 years.)

Year. 1st April to 31st March.	*Societies.*	*Individuals.*	*Total No. of Bulls.*
1914-15*	369	43	497
1915-16	489	28	633
1916-17	543	15	659
1917-18	578	14	710
1918-19	604	7	721
1919-20	568	6	675
1920-21	561	6	668
1921-22	726	3	847
1922-23	831	1	947
1923-24	840	1	978

* Including the period 1st February, 1914—31st March, 1914.

This increase, though not large, is satisfactory in view of the restrictions on movement of stock in force during a large portion of the year owing to the prevalence of foot-and-mouth disease. In districts not so hampered the Ministry's Livestock Officers report very favourably on the progress of the scheme and the marked improvement in the young stock where premium bulls have been in use for some time. It is satisfactory to note the general and continued success of premium sires and their progeny at sales and shows. One of the Ministry's Livestock Officers reports that stock by premium bulls have been successfully shown at every show in his district, and at one of these shows every first prize was won by animals which were sired by premium bulls. In another instance twelve animals under two years old sired by a premium bull secured the highest average at the market on that day, and as a result of this success four new members joined the society in order to have the benefit of using this sire. Another of the Ministry's Livestock Officers recently attended a meeting of small holders for the purpose of explaining the advantages of the scheme, and at the close of the meeting eight of the number present guaranteed to advance £10 apiece to start a society and buy a pedigree bull. This decision was partly attributable to the fact that two farmers present at the meeting had seen for themselves the improvement resulting from the work of another society in the district, and emphasises the value to agriculturists of practice over precept.

In some dairying districts, even where calves are reared in considerable numbers, there is still much leeway to be made

up. The high prices still commanded (and likely to be) for suitable bulls of dairy strain may partly account for this, and continued effort is necessary to convince such breeders that it is poor economy to continue using nondescript sires about whose breeding little or nothing is known.

There was again a drop in the prices of bulls, other than those of dairy type, purchased during the year under review, and the average price of all the bulls provided was consequently lowered. The following table shows the number of bulls of each breed subsidised and the average cost for the first year and last two years of the scheme:—

NUMBERS AND PRICES OF BULLS OF EACH BREED.

Breed	1914-15		1922-23		1923-24	
	No.	Average Cost	No.	Average Cost	No.	Average Cost
		£ s. d.		£ s. d.		£ s. d
British Friesian ...	—	—	6	77 15 8	5	74 16 0
Devon	16	40 17 6	90	59 10 3	106	57 16 0
Guernsey	—	—	7	53 9 3	12	51 10 0
Hereford	63	33 7 6	84	58 3 4	100	50 19 0
Lincoln Red .	33	31 10 0	94	63 14 11	101	55 11 0
Red Poll	—	—	1	78 15 0	—	—
Shorthorn ...	337	37 17 0	553	64 16 3	573	57 10 0
South Devon ...	6	36 11 6	17	58 11 6	15	47 5 0
Welsh Black ...	35	29 9 0	64	52 2 11	62	52 1 0
Other Breeds ...	7	29 4 6	—	—	—	—
All Breeds ...	497	36 0 0	916	62 11 9	974*	56 3 0

* 978 bulls were located, but grants in respect of 4 were in suspense at the end of the year.

As was the case in the preceding year the service fees varied from 2s. 6d. to 10s. 6d. It will be seen from the subjoined table that there was again a substantial increase in the number of bulls serving at 5s., but the number serving at a higher fee remained about the same (*i.e.*, 277 compared with 271 in the previous year). The average service fee for all the bulls was 5s. 3d.

SERVICE FEES.

Year	*2/6*	*3/-*	*3/6*	*4/-*	*4/6*	*5/-*	*5/6*	*6/-*	*6/6*	*7/-*	*7/6*	*8/-*	*8/6*	*9/-*	*10/-*	*Over 10/-*
1914-15	265	57	41	42	3	88	—	—	—	—	1	—	—	—	—	—
1922-23	50	40	28	84	10	430	3	53	2	10	141	7	8	2	45	6
1923-24	51	46	25	71	9	491	2	84	2	12	126	6	7	1	26	5

Boars.—There was a satisfactory increase in the number of boars available during the year ended 31st March, 1924 (*i.e.*, continued from previous years with renewed grants or located in fresh districts during the year), the number being 638 as compared with 569 in the preceding year. The difficulty of forming Boar Societies is apparent in the fact that of the 638 boars available 550 were provided by individual owners.

BOAR SCHEME.
(Showing the number of Boars subsidised during the past 10 years.)

Year. 1st April to 31st March.	*Societies.*	*Individuals.*	*Total No. of Boars.*
1914-15*	115 ...	— ...	115
1915-16	180 ...	— ...	193
1916-17	186 ...	15 ...	216
1917-18	172 ...	92 ...	264
1918-19	156 ...	167 ...	350
1919-20	120 ...	225 ...	399
1920-21	135 ...	285 ...	441
1921-22	113 ...	416 ...	550
1922-23	93 ...	451 ...	569
1923-24	78 ...	541 ...	638

* Including the period 1st February, 1914—31st March, 1914.

In several districts more applications for premium boars were received than could be met from the number of grants available. In other districts a strong preference for a local type of pig not recognised as a distinct and established breed has prevented the fullest use being made of the scheme. In some such districts efforts are being made to register and form herd books, and to secure recognition from the Ministry for the purpose of the Boar Scheme. In this connection it may be noted that the Ministry has recently, after consultation with its Advisory Livestock Committee, extended this recognition to the Welsh pig.

As in the case of bulls, premium boars and their progeny have attained general success at sales and shows, the natural result of the improvement which has taken place in districts which have been served by premium boars for some years.

Increasing interest has recently been shown in the production of the most suitable type of pig for bacon factories, and efforts are being made to meet the requirements of local factories in this respect by encouraging the most suitable type of sires.

It will be seen from the following table that the average price of the boars located under the scheme during the year

under review was £14 6s. 2d., which was slightly lower than the previous year's average, viz., £15 0s. 4d. The most popular breeds at present are the Large White, Large Black and Middle White.

NUMBERS AND AVERAGE PRICES OF BOARS OF EACH BREED.

Breed	1914-15		1922-23		1923-24	
	No.	Average Price	No.	Average Price	No.	Average Price
		£ s. d.		£ s. d.		£ s. d.
Berks	10	8 0 0	11	18 2 3	10	17 1 9
Cumberland ...	—	—	30	16 5 0	29	14 5 3
Essex	—	—	4	23 7 6	5	19 9 9
Glos. Old Spot ...	7	7 1 0	37	21 8 0	32	15 8 3
Large Black ...	18	7 5 6	141	14 12 7	138	13 4 4
Large White ...	64	7 3 0	199	13 13 10	250	14 11 9
Lincoln Curly Coat	4	8 4 6	31	12 3 10	35	11 16 10
Middle White ...	12	6 17 0	77	15 11 7	98	14 16 9
Large White Ulster	—	—	2	16 0 0	6	16 6 8
Tamworth ...	—	—	1	20 0 0	2	18 18 6
Wessex Saddleback	—	—	13	16 2 3	14	14 12 6
All Breeds .	115	7 5 3	546	15 0 4	619*	14 6 2

* 638 Boars were located, but grants in respect of 19 were in suspense at the end of the year.

The service fees varied from 2s. 6d. to 10s. Considerably more than one-half the boars served at a fee of 5s., while a third of the remainder served at 7s. 6d. The average fee for all the boars was 5s. 5d., a trifle lower than in the previous year.

SERVICE FEES.

Year	2/-	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	10/-	Over 10/-
1914-15	21	62	10	5	6	—	2	—	—	—	—	—	—	—	—	—
1922-23	—	7	12	13	37	5	300	—	51	4	2	99	—	4	13	1
1923-24	—	9	9	12	44	1	368	1	58	2	4	104	—	2	5	—

Milk Recording.—No part of the Livestock Scheme has made more satisfactory progress than milk recording. Notwithstanding the many serious obstacles arising out of the abnormal conditions prevailing during the first five or six years of the operations of the scheme, the movement has continued to spread until at the present time practically every county in England and Wales has its own recording society or societies, and no district is outside the radius of one or other of these societies. During the year under review 416 new

members, owning 10,000 cows, have been enrolled, and in view of the hampering restrictions consequent on the serious outbreaks of foot-and-mouth disease over a large part of England and Wales this increase may be considered satisfactory. The following table shows the growth of the movement since its commencement.

	*Year.**	*Societies.*	*Members.*	*Herds.*	*Cows.*
1st April to 31st March.	1914-15	16	264	306	7.331
	1915-16	20	350	398	9,811
	1916-17	22	441	495	12,950
	1917-18	25	503	555	14,404
1st October to 30th September.	1917-18	27	639	708	19,793
	1918-19	38	1,191	1,332	37,880
	1919-20	46	2,075	2,312	61,323
	1920-21	52	3.328	3,664	97,903
	1921-22	55	3.949	4,362	117,023
	1922-23	55	4,365	4,767	127.151

* Prior to 1st October, 1917, there was no uniform year for societies.

Average Yield of Herds Recorded.—The annual returns furnished by the 55 societies for the recording year ended 1st October, 1923, show that of the 127,151 cows and heifers recorded, 54 per cent. were cows which had been retained in the herds for the full year, and that the average yield of these 68,349 cows was approximately 7,000 lb., an appreciable increase over the averages of previous years.

Many societies averaged considerably more; for instance, the Hampshire Society with 3,251 full-year cows averaged 7,601 lb.; and the Essex Society, which for the year ended October, 1918, had only 407 full-year cows yielding on an average 6,531 lb., has shown remarkable development, having had in the last milk-recording year 4,388 full-year cows whose average yield was 7,499 lb., a tenfold increase in membership and of approximately 1,000 lb. in the average yield of the cows.

When the milk-recording movement was initiated by the Ministry the thousand-gallon cow was talked about and sometimes got into print, and though the object of the scheme is not to encourage the production of phenomenal milk yielders, it may be of interest to record that last year 125 herds—not cows—averaged 10,000 lb. per cow or over: good evidence of the value of milk recording and of the results obtained by careful weeding out, selection and breeding.

The following statement compares the average annual yield of (1) all cows and heifers recorded, and (2) of the cows

recorded for the full year for each year since the uniform milk-recording year was fixed :—

Year: 1st Oct. to 1st Oct.	No. of Societies	Particulars of all Cows and Heifers recorded			Particulars of Cows recorded for full year			
		No. of Cows and Heifers	Total Yield	Average Yield	No. of Cows	Percentage of Total Cows	Total Yield	Average Yield
			gal.	gal.			gal.	gal.
1917-18	27	19,793	8,426,958	426	8,775	44	5,255,923	599
1918-19	38	37,880	16,204,941	450	17,989	47	10,543,516	579
1919-20	46	61,323	29,344,887	479	27,266	44	17,363,347	637
1920-21	52	97,903	48,512,380	495	48,248	49	30,892,620	640
1921-22	55	117,023	60,463,617	517	63,318	54	41,208,073	651
1922-23	55	127,151	67,904,224	534	68,349	54	46,956,565	687

While the total average yield continued to improve steadily, a much more marked advance is shown in individual herds as a direct result of the more systematic and economic management following the adoption of milk recording. As an instance of this, in the returns for 33 of the herds (of over 20 cows) of one society which have been recorded from 1917-18 to 1922-23, there was an average increase in the yield per cow of full-year cows of 92 gallons. The maximum increase shown by a herd was 234 gallons per cow.

Milk Record Certificates.—The number of milk record certificates issued to members was 2,065. This number represents 1.62 per cent. of the total number of cows recorded. Of the 2,065 certificates issued, only 155 were for yields of less than 6,000 lb., 1,367 were for yields between 6,000—10,000 lb., and 543 were for yields of over 10,000 lb.

Register of Dairy Cattle.—The seventh volume of the Ministry's Annual Register of Dairy Cattle,* covering the year under review, has been issued. It contains particulars of 1,321 cows (belonging to 271 members) in respect of which certificates have been issued by the Ministry showing that they have certified yields of 8,000 lb. or over of milk during the milk-recording year ended 1st October, 1923, or an average of 6,500 lb. for that year and one or more preceding consecutive years. Twelve recognised breeds or types are represented in the seventh volume, and there are, in addition, 57 crossbred cows (*i.e.*, cows which do not conform to one recognised breed or type), whose milk yields have justified their inclusion under the standard required. Of the 1,321 cows entered in the

* Price 2s. 6d., post free, from the Ministry.

seventh volume, 1,165 gave over 8,000 lb. of milk during the year, and 156 were entered on an average of 6,500 lb. or over. Of the 1,165 cows which were entered on the one year's yield 482 gave over 10,000 lb.

The seventh volume of the register contains the second list of cows in respect of which certificates of merit have been issued certifying that such cows have yielded not less than 24,000 lb. of milk over a period of three consecutive years and have calved at least three times during that period. This section, and the sections for dairy bulls, have been better supported than was the case in the previous volume, and it is hoped that in course of a few years the information given in these sections will constitute a valuable part of the register. Steps are being taken by the Ministry to popularise the register and to increase its scope and usefulness to all classes of dairy farmers.

After consultation with its Advisory Live Stock Committee the Ministry has made certain important changes in the conditions of entry into the Register, the principal of which are:—(1) the issue of a Certificate of Milk Record will not be required as a condition of entry; (2) entry will be made on the basis of one year's yield only.

The alterations have been made with the object of securing a more comprehensive and valuable book of reference for the use of members of milk recording societies and others interested in dairy cattle, and Volume 8 of the Register will contain entries of approximately 5,000 of the highest yielding cows of all breeds and types. A copy will be presented free to each member of a milk recording society who records under the Ministry's scheme.

Cost of Milk Recording.—The marked tendency for costs to increase which had been noticed in previous years was checked in the year ended 1st October, 1922, and, as was anticipated, the results for the year under review show a distinct reduction in costs notwithstanding increased activities on the part of societies. About 30 per cent. of the societies have been able to reduce their levies per cow by 6d. or more, and with very few exceptions, societies are in a sound financial condition.

Commercial Value of Milk Recording.—The commercial value of milk recording continued to be demonstrated by the prices realised at sales for recorded non-pedigree cattle and their progeny, and although, as was anticipated, the exceptional prices realised during the boom period of 1921 were not so evident,

STATEMENT giving particulars of 55 Milk Recording Societies operating during the year ended 1st October, 1923.

(The Societies are arranged in order of total number of animals recorded).

NAME OF SOCIETY.	Number of Members.	Number of Herds.	Total No. of animals recorded.	No. of cows recorded for full year.	Av. yield of cows recorded for full year.
					lb.
Essex	215	238	7,902	4,388	7,499
East Sussex	190	229	6,730	3,595	7,311
Hampshire	176	194	6,166	3,251	7,014
Yeovil & Shepton Mallet	150	171	5.404	3,191	6,749
Berkshire	135	150	5,378	2,788	6,845
Hertfordshire	159	178	5,290	2,681	7,200
Kent	163	186	4,974	2,613	7,200
North West Wilts	106	119	4,714	2,736	6,902
Dorset	77	103	4,568	2,720	6,599
Surrey	170	180	4,360	2,174	6,796
Norfolk	144	165	4,253	2,392	7,601
West Sussex	109	119	3,738	1,815	7,255
Oxford	102	109	3,666	1,992	6,950
Salisbury	61	86	3,654	2,338	7,524
Lancashire	131	139	3,574	1,485	6,735
Warwickshire	121	131	3,137	1,604	7,070
Leicester	100	103	2,718	1,447	7,414
Suffolk	107	116	2,513	1,642	7,365
South Devon	97	106	2,452	1,198	6,309
Northants	91	103	2,320	1,271	6,668
Yorkshire	140	141	2,317	1,018	7,333
Shropshire	70	78	2,163	1,383	7,309
Cambridgeshire	83	91	2,150	1,239	7.415
Cheshire	58	64	2,141	1,031	7,152
Cumberland	141	143	2,026	891	6,089
Stafford	71	75	1,837	982	7,519
Nottingham	53	55	1,764	888	6,821
Buckingham	66	71	1,709	835	8,239
Derby	48	51	1,685	809	7,329
Bristol & Bath	76	77	1,537	831	7,281
Denbigh & Flints	70	72	1,459	901	6,685
Worcestershire	62	65	1,416	748	6,948
Peak	57	57	1,266	480	7,004
Warminster & Mere	27	31	1,191	877	6,849
Cadbury	37	45	1,152	761	6,741
Tees Valley	30	37	1,080	438	7,334
East Devon	64	64	1,016	467	6.716
Bedfordshire	36	37	945	510	7,436
Kendal & S'th Westmorland	47	47	856	386	5,841
Frome	20	20	853	567	6,431
Cornwall	50	50	777	446	6,020
North Somerset	31	35	764	473	6,898
Lincolnshire	33	36	755	361	7,175
Anglesey & Carnarvon	60	62	753	432	5,454
Allendale	40	41	741	433	7,034
United Counties	47	48	732	421	6,544
Monmouth	34	36	627	327	6,511
Herefordshire	27	27	620	329	7,026
Campden, Moreton and District	33	33	575	366	6,940
Gloucester & District	32	34	563	295	6,848
Melton Mowbray	26	26	556	295	6,682
Cotswold	25	25	523	359	7,474
Montgomery	23	23	421	223	6,031
Highbridge	15	16	382	226	7,018
Glamorgan	29	29	288	Commenced 1st April, 1923.	
TOTALS	4,365	4,767	127,151	68,349	7,042

it is noteworthy that milk records are much more frequently seen in sale catalogues and asked for in private transactions than was formerly the case.

Advice on Rationing.—Much greater interest has been evinced in the schemes instituted by the County Agricultural Organisers for the economic feeding of dairy cows and butter fat testing. The very useful advice and assistance given by the Organisers are much appreciated and the adoption of balanced and economical rations should prove of great value—financial and otherwise—to members of milk recording societies.

Calf Marking.—The Ministry's Calf and Bull Marking Schemes, the adoption of which is optional, have now been taken up by all but two societies, and interest is steadily growing as members realise the value of officially identifying the progeny of their recorded stock. The number of animals marked under this scheme during the year was 12,647 as compared with 11,517 during the preceding year.

Sheep.—Since 1919 the Ministry has given some financial assistance towards the improvement of Welsh Mountain Sheep. Grants, up to a maximum of £10 for each ram provided, at the rate of 3s. 4d. per ewe served, were made to 14 societies in respect of 17 approved pedigree rams during the year ended 31st March, 1924. The average hiring fee of the rams was £9 13s. and the average service fee 1s. 5d. The number of ewes served was 1,020, an average of 60 per ram.

The scheme, which is in its infancy, promises well, and one excellent result of its operation has been that several members of societies have purchased pedigree rams of their own.

Heavy Horses.—It was possible to revive the grants to Heavy Horse Societies, which were discontinued after 1921 owing to the urgent demand for economy at that time. As the announcement that grants would be available was only made in February last full advantage could not be taken of the scheme for the service season of 1924. It is confidently anticipated, however, that next year it will be possible to continue the good work accomplished by the scheme during the years 1914-1921.

The following are the principal memoranda used in connection with the livestock operations of the Ministry, and copies of them can be obtained free of charge on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 :—

Leaflet 282.	Scheme for Improvement of Live Stock.
Leaflet 146.	The Value of Records of the Milk Yields of Cows.
No. 609/T.L.	Bull Grant Regulations.
No. 392/T.L.	Milk Recording Regulations.
No. 466/T.L.	Boar Grant Regulations.
No. 89/T.L.	Heavy Horse Regulations.

Light Horse Breeding.—The administration of the Light Horse Breeding Scheme was transferred to the War Office on 1st April, 1924, and the following report on the year 1923-24 marks, therefore, the termination of the Ministry's active interest in the scheme which was inaugurated in 1910, and has thus been in existence for 14 years. The operations of the scheme during that period have been described in the annual reports published by the Ministry.

During the year 1st April 1923—31st March, 1924, the scheme was carried on by the Ministry on the usual lines. It was satisfactory that sufficient stallions of the requisite merit were forthcoming at the Thoroughbred Show in 1923 to enable the full number of King's and Super Premiums to be awarded, which was not the case in the preceding year.

Premiums Awarded for 1923 *Season.*—The following premiums were awarded for the season 1923:—12 Super Premiums, 48 King's Premiums and 15 Ministry's Premiums (all thoroughbred horses except 3 Ministry's Premiums, which were awarded to 1 Hunter stallion and 2 Cleveland Bay stallions), 5 Riding Ponies, 18 Welsh Cobs, 3 Welsh Roadsters, 4 Dales Ponies, 5 Fell Ponies, 15 New Forest Ponies and 40 to Mountain Pony Stallions in Wales.

Service Season, 1923.—The service season of 1923 showed considerable improvement on that of 1922, the average number of mares served by both the King's and Ministry's premium stallions showing a marked increase. The numbers of mares served by the various classes of stallions were as follows:—

	No. of Mares Served.	*Average per Stallion.*
12 Super Premiums	966	81
48 King's Premiums	3,437	72
15 Ministry's Premiums	886	59
5 Riding Pony Premiums ...	208	42

Foaling Results from Service Season, 1922.—The foaling results from the 1922 service season showed a slight improvement on the previous year. The foaling percentage of stallions is calculated upon Returns furnished to the Ministry by the

mare owners, and the results from the 1922 service season were as follows:—

	No. of Mares served in 1922.	*No. of Returns furnished to Ministry.*	*Average Percentage of Foals.*
12 Super Premiums ...	855	841	56
45 King's Premiums ...	3,033	2,952	53
15 Ministry's Premiums ...	872	845	54
5 Riding Pony Premiums	205	201	63

The highest percentage (73) was obtained by "Ballyvodock," now owned by Mr. Terry O'Brien, Ballyvodock, Midleton, Co. Cork.

Thoroughbred Show, 1924.—At the request of the War Office the Ministry made the usual arrangements in conjunction with the Hunters' Improvement Society for the Annual Show of Thoroughbred Stallions for the purpose of awarding premiums to stallions for the service season 1924. The show was held at the Royal Agricultural Hall on 4th, 5th and 6th March, and the Judges were Mr. Ernest Bellaney and the Hon. Alexander Parker. The number of entries was 94, seven more than in 1923, and of these 30 were stallions which had not previously been shown. The full number (60) of Premiums (including 12 Super Premiums) was awarded, and the King's Cup was won by "Scarlet Rambler" belonging to Captain T. L. Wickham Boynton and Henry A. Cholmondeley, the Reserve horse being "Gay Lally" belonging to the Compton Stud, thus reversing the positions occupied by these two stallions during the previous three years.

Horse Breeding Act, 1918.—During the licensing year 1st November, 1922, to 31st October, 1923, there was again a marked decrease in the number of stallions licensed under this Act, the number being 2,761 as compared with 3,479 in the preceding year. The proportion of stallions for which licences were refused remained almost the same. There were 136 refusals, 15 of which were after appeal, the numbers for the previous year being 165 and 16 respectively.

Of the 2,761 licensed stallions, 2,512 were pedigree animals and the remaining 249 were horses that were not entered or accepted for entry in any recognised stud book.

The following tables show the number of stallions of each breed concerned that were licensed or rejected, and the number refused licences in respect of the various prescribed diseases or defects:—

NUMBER OF STALLIONS LICENSED OR REFUSED.

	Pedigree.		Non-Pedigree.*	
Heavy.	*Licensed.*	*Refused.*	*Licensed.*	*Refused.*
Shire	1,568	88	66	3
Clydesdale	185	13	6	1
Suffolk	186	5	1	1
Percheron	47	1	—	—
Others	—	—	61	2
Light.				
Hackney	179	8	30	—
Thoroughbred	140	6	3	—
Arab	22	2	4	—
Hunter	6	—	5	—
Cleveland Bay	7	—	—	—
Yorkshire Coach	2	—	1	—
Welsh Roadster	3	1	1	—
American Trotter... ...	1	—	7	—
Others	—	—	12	—
Ponies (including Welsh Cobs)	166	2	52	3
TOTALS	2,512	126	249	10

* Non-pedigree stallions are arranged as far as possible under types.

NUMBER OF STALLIONS REJECTED FOR THE PRESCRIBED DISEASES AND DEFECTS.

Roaring... ...	29	Defective Genital Organs	2
Whistling ...	41	Stringhalt	4
Sidebone ...	21	Shivering	7
Cataract ...	12	Navicular Disease ...	1
Ringbone ...	8	General Unsuitability ...	1
Bone Spavin ...	10		
		TOTAL	136

Twenty-three appeals were made against refusals of licences, and in 8 cases these were successful.

Notwithstanding the decrease in the number of stallions licensed the Ministry has information which suggests that the number of unsound stallions which formerly travelled at very low fees, and which constituted the most serious hindrance to the grading up of horse breeding, have been practically eliminated from the road. Since the Horse Breeding Act came into force the Ministry's inspectors and livestock officers and the police have endeavoured to secure observance of the Act by stopping stallions on the road and requiring the production of the licences, and in cases where the regulations have been infringed proceedings have been taken by the police. The fact that the number of prosecutions is steadily declining is evidence of a more general knowledge of and compliance with the Act on the part of stallion owners.

THE FRIT FLY AND ITS RELATION TO THE YIELD OF OATS.*

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DURING recent years we have made considerable advances in our knowledge of the habits of the frit fly, thereby gaining precise information where previously we have had to rely on more or less general impressions. This is the case particularly with regard to the prevalence of the fly in the fields. The fly swarms in the fields three times during the year, first in spring, then in mid-summer and again in late summer. Twice a year, particularly, the oat crop is liable to suffer heavily from this pest. The maggots produced by the spring swarm attack and kill the stems of the oat plants, while those produced by the mid-summer swarm destroy the flowers and the grain.† Obviously then, it has become a matter of importance to know more exactly when an oat crop is likely to suffer maximum damage by the frit fly and also how these periods of possible heavy infestation are influenced by weather and condition of crop, because such information provides a sound basis for the elaboration of preventive measures, direct or indirect.

With this aim, records of the number of frit flies present in the fields day by day, have been collected near Oxford during the period 1919-1922. The procedure followed was simply that of sweeping with a net, regularly and in a definite manner in the oat fields, carefully noting the number of frit flies caught on each occasion. The records collected in 1922 have been expressed in the form of a curve (see chart), to construct which the average number of flies collected weekly was plotted against the corresponding dates of collection. This curve shows clearly the periods of the year when the three generations are present in the field in their greatest numbers. If the chart is carefully examined, in conjunction with the following table, the relation of these generations to each other and to the crop will be readily understood.

	Swarming period of fly.	Approximate date of maximum swarming.	Position of egg and maggot.
Generation III	May to mid-June	May 26	Stem of young oat, other cereal or grass
Generation I	June to mid-Aug.	July 15	Seed of oat, stem of cereal or grass.
Generation II	Aug. to mid-Sept. or later	Aug. 19	Stem of grass or volunteer cereal.

* See "Frit Fly on Oats in the Four Northern Counties," by R. A. Harper Gray, this *Journal*, March, 1923, p. 1109.

† General information about the frit fly may be obtained from the Ministry's Leaflet No. 202.

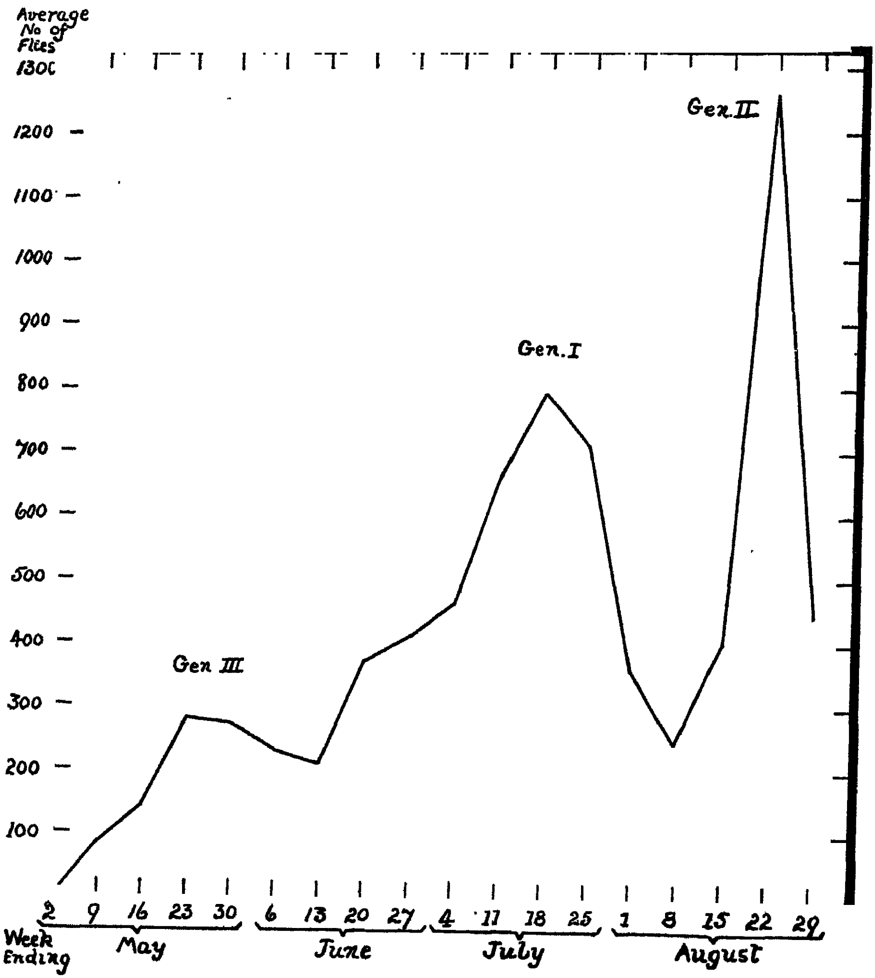

FIG. 1.—Chart showing variations in the Frit Fly Population in the field during 1922.

This curve is almost certainly typical for the southern and midland counties generally, although this is not yet proved to be so by general field observations. It is possible that in more northerly districts the generations will be found to be more sharply defined, which means that the crops would not be menaced by the fly so continuously as they are in the south.

In addition to these facts, we have further information about the times of appearance of these swarms from year to year. Similar field work during the years 1919-1921 has shown that even such pronounced differences in weather conditions as were experienced during the period 1919-1922, failed to move the times of maximum swarming of these three generations of flies outside periods of seven days about the dates indicated in the table. It is this regularity in the times of appearance of the flies in maximum numbers which is of practical importance in relation to the yield from any particular crop of oats, as is explained below.

The August-May Generation.—At any time when a cereal crop is not available the fly deposits its eggs on grasses, and it is important to note that its maggot can exist successfully at any time during the year on at least 15 different species of grass, of which the most important, in order of preference, are common oat grass and its variety, onion couch grass, wall barley, slender foxtail and Italian rye grass. During the winter the fly, in its maggot stage, feeds inside the stems of these and other grasses, and the adult flies from these maggots appear from the end of April to the middle of June, and in maximum numbers about 26th May.*

The flies of this spring swarm must of necessity find suitable breeding places and, roving over the land, they eventually discover cereal or grass stems in fit condition to receive their eggs. The maggots hatching out from these eggs check the growth of the oats in the spring by destroying the internal parts of the stems and when they in turn swarm in the adult state they cause the increase in the fly population shown by the curve in June and July.

The practical importance of the spring swarm depends on the state of growth of the oat crop at the time when the greatest number of flies is present in the field (end of May). In the case of a crop sown early, *i.e.*, during February or March, the

* It is convenient to designate these flies as Generation III, regarding them as belonging to the previous year's cycle, since they are derived from eggs deposited in the autumn.

main stems and early tillers should be well grown normally by the end of May, and therefore would escape infestation;* and only the less important late tillers would suffer from the attack of the maggots. April sowings would naturally produce more stems suitable for the fly, more particularly if growth should be in any way checked during April and May, the loss of crop being correspondingly heavier than in the previous case.

Later sowing would cause the plants to send up main stems eminently suitable for the flies at the time when they would be most numerous in the field; the early death of the main stems would then lead to premature tillering, these secondary stems also being formed at a time when they are liable to heavy infestation, causing severe losses.

If the oat plants are in an unsuitable condition for egg-laying, the flies seek wild grass stems. The succeeding generation (Generation I, of June-July) may still cause damage to the seed of the crop which was more or less immune earlier in the year, especially if the wild grasses occur in the neighbourhood of the oats.

The extent of the damage to the crop in spring depends therefore on the condition of the crop in the latter part of May. The nearer the early growing period approaches the time when the spring swarm is most abundant, the greater will be the loss of stems of seed-bearing value, *i.e.*, loss of crop.

The June-July Generation.—The flies of the June-July swarm may deposit their eggs on late tillers of oats or grass, on the vigorous stems carrying the still concealed developing ears or on the grain in the exposed ear, because the crop generally passes through all these stages while these flies are present in the field. Thus the damage caused by the maggot at this time of year varies; its activity may result in the loss of late but probably unimportant tillers, in the absence of flowers on the ear (blindness) or in the destruction of seed.

The economic importance of the attack on the crop at this stage depends on the relation between the times of seed formation and maximum swarming (about 15th July). When the flowering heads appear early in June, the flowers and the developing grain are exposed to the minimum number of flies, as reference to the chart will show. Even at this time of year the grain may suffer some damage, as there are always some

* The condition of stem which discourages egg laying is now being investigated in collaboration with Mr. J. C. F. Fryer.

flies present in the field; 10 per cent. of seed damage is a low estimate for the Oxford district, even under these comparatively favourable conditions. As the time of shooting of the ears approaches nearer and nearer to the middle of July the extent of the damage to the grain will increase, as the flowers become exposed to an increasing number of flies. Since the maggot is able to attack the seed until the milk stage is reached, the maximum amount of damage may be expected when this range of growth falls about the middle of July; in these circumstances 70 per cent. of the seed may be damaged.

The July-August Generation.—The maggots living in the seed (or other location mentioned above) give rise to the flies which swarm in August (Generation II). Their economic importance lies only in the fact that they are the parents of the spring swarms. They lay their eggs on grasses, the resulting maggots mining in the grass stems until the following spring, when the annual cycle is completed by the swarming of Generation III, which migrates to the oats, if available.

The yield of grain from an oat crop depends on the number of sound vigorous stems capable of producing grain, as well as on the extent of the attack on the grain. It is well known that the liability of the stem to attack decreases rapidly with age, therefore, if the spring swarm appears fairly constantly in time, one would expect early-sown crops to produce sound main stems and early tillers, the later tillers bearing the brunt of the attack but at the same time having small, if any, yield value. A late-sown crop would obviously be liable to attack throughout the greater part of its existence, and the nearer the spring growing period approaches the period of maximum swarming in spring, the greater will be the loss of valuable shoots. The position with regard to the grain is similar; the shorter the time between the periods of seed formation and maximum swarming of Generation I in July the greater will be the liability of the seed to infestation, owing to the increase in population about the middle of July.

Hence we have here the explanation of the necessity for early sowing in the case of spring oats and a reason for the increasing popularity of winter oats in infested districts. The importance of initiating rapid early growth and, when necessary, stimulating growth, is clearly indicated. Varietal differences may, in this connection, be of service to the farmer.

The regularity of the swarming of the fly from year to year is advantageous to the farmer inasmuch as he may take advan-

tage of this fact in regard to the time of sowing, the application of artificial manures to hasten early growth and the selection of varieties, endeavouring always to force the crop beyond the more critical stage by the end of May. Much more research work is required before precise information can be given in relation to these particular points, but considerable knowledge can be acquired by the grower himself from his own observation.

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THE BADGER: ITS HABITS AND LIFE HISTORY.

H. MORTIMER BATTEN, F.Z.S.

Breeding and Young.—The breeding habits of no wild animal have given grounds for so much difference of opinion as those of the badger. Zoologists have been reluctant to accept that the wild, free badger carries her young for so long a period as twelve months, but we know that young badgers are born in the early spring—March and April—and that at the same period sexual excitement among the males is at its height. There are, moreover, numerous cases on record of sow badgers being taken into captivity during late spring and giving birth to cubs the following spring, and all the facts available seem to show that the female mates within a few days of parturition, and so carries her young till the following spring. There are no indications of sexual excitement in the autumn, and I have never heard of cubs being born later than July—such late broods being, of course, the result of a late mating. Again, there are cases on record of captive sow badgers giving birth to cubs after fourteen months in captivity, when there was no possibility of mating during that period, while there are also proven cases of young being born within seven months of mating. It seems possible that captivity may upset the ordinary course of nature where this beast is concerned.

Usually there are two or three cubs to the litter, and they are blind for about a fortnight. They are very attractive little beasts, and until almost full grown can be handled without fear of their biting. Their usual cry consists of a high-pitch squealing, almost identical with the sound created by rubbing one's fingers on a wet sheet of glass.

About the end of June or during July the home burrow is left by the family, and they take up residence in a neighbouring warren—generally within a distance of two miles—leaving the

Fig. 1.—The Badger.

old den to air and sweeten. They—or other badgers—will probably return to it late in the autumn, but badgers invariably move from warren to warren at regular periods, no warren being occupied sufficiently long for it to become verminous and unhealthy. In these ways badgers appear to keep free from those diseases which take such tremendous toll of many less advanced beasts.

Badger warrens exist all over the country, some of them of very considerable antiquity, and our list of place names derived from the badger, such as Brockenhurst and Brockwood, is a long one.

Winter Sleep.—Hibernation is more complete than in the case of the squirrel, and less complete than in the case of the hedgehog. Where badgers are numerous the tracks of restless individuals are to be seen in the snow through the winter, but it may be taken that for every badger astir in December there are a dozen hibernating—unless, of course, the winter be an unusually mild one. In the Highlands, where the badgers belong almost exclusively to the extreme heights, that is to altitudes of 2,000 feet and above, they hibernate in the true sense, though here their strongholds are the immense cairns, which shelter also the fox, the marten cat and the wild cat.

In the autumn the badger sett can always be identified by the great amount of bedding left about the burrows. Fresh bedding is gathered regularly, and when the period of hibernation comes, the burrows are full of grass or bracken as the case may be, in which the animals sleep their winter sleep, and which helps to exclude the draught. Sometimes, but not generally, for the sake of warmth, several of the holes are closed from within when hibernation begins.

Sanitation.—Regarding the cleanliness of badgers anyone who has warrens under observation the year round will observe evidence of the terrific spring-cleaning upheavals which take place, generally in March. The whole warren is then scoured from end to end, and sometimes two or three cart loads of earth and litter are removed from the front entrances. These scouring activities go on to a less extent the year round. The animals are fond of dragging bedding into the warrens, but every week or so the old bedding is dragged out, and a fresh, clean supply substituted. Not only this, but badgers never haunt one burrow sufficiently long for it to become foul, changing their quarters every three months or so as previously stated.

Foxes have no sanitation to speak of, and the young are particularly dirty and untidy in their home lives. Badgers, however, reserve a special plot at some distance from the burrow mouth, and that place only do they recognise for the necessary purpose. Droppings are never left inside the burrows, except possibly, in the case of very young cubs whose habits are not formed, and at that time they are in their mother's care.

One can imagine, then, that fox cubs, with all their litter and stink, make very distasteful lodgers for the house-proud badger, yet being slow-footed and a lover of peace, he generally puts up with them.

Food.—I have never known badgers to drag food into their warrens—certainly not the food which would make the warren foul—whereas foxes habitually do. Badgers live chiefly upon vegetable matter—roots of all kinds. Also they eat insects, and fresh meat when it comes to hand during their short-sighted pig-like foragings. Rats and rabbits they especially like, but if a wild badger is watched when out on a foraging expedition it will be observed at once that he is not a hunting animal, since normally he is interested in nothing beyond the radius of a yard from his nose. He will make a weasel-like dash of perhaps twelve feet at anything moving, but he is not very rapid, and knows it, and if that dash fails he goes on with his rooting, the other matter forgotten.

Badgers are not Lamb Killers.—It is sometimes stated that badgers kill lambs. A correspondent in North Wales stated that his good faith in the badger's innocence had been much shaken by the discovery of the remains of lambs in the badger warrens, while prevalent opinion in his part condemned the animal as an habitual lamb killer.

Anyone who has studied the badger at all thoroughly is sure to have come across evidence of this kind, which not uncommonly has sufficient circumstantial strength to result in general warfare against the badger kind, and as the matter is of importance it may usefully be discussed.

It is unwise to say definitely that any wild creature does or does not do a certain thing, since circumstances adjust their habits, and exceptions of all kinds occur. Sometimes a badger escapes from captivity, when if hungry, it will attack almost any kind of live stock. In one case at Gillamoor, North Yorkshire, a wild badger was taken and kept in captivity for about a week, during which time it ate nothing—owing in the first place to the fact that no suitable foods were offered it, and

secondly because a wild badger under any circumstances eats little during its early confinement. The animal broke loose and overturned a coop two hundred yards away, killing the broody hen and eating the sitting of eggs. This was regarded as conclusive proof of the animal's destructive habits, but clearly it was a case of man himself having upset the ordinary course of nature.

On another occasion a badger which had been captive several months got out, and, gaining the keeper's rearing pens, upset several nesting boxes and did a considerable amount of damage during the night; but one has an understanding sympathy for the captive returning thus to plenty and freedom.

However, the North Wales correspondent first referred to clears the badger of guilt in his case by stating that the remains of lambs were found *in the warrens.* A badger never fouls its den in this way, and the work was unquestionably that of foxes, which, having a high appreciation for Brock's wonderful architecture, thrust themselves upon him as uninvited lodgers. It is rare, indeed, to find a badger sett of any size which is without its fox tenants, and I have seen young badgers, young foxes, and young rabbits emerging at sundown from the same warren.

The badger not only has to put up with an untidy lodger, who fouls the burrows which the badger itself tends with Martha-like cleanliness, but, since the fox shadows him everywhere he goes, he forfeits his life as a result of Reynard's crimes.

The killing of lambs by badgers has certainly occurred, but the work of the badger is unmistakable in that he bites the lamb behind the shoulder and invariably leaves it where killed. On the rare occasions when this has occurred, moreover, the shepherds have only themselves to blame for it. Lamb killing in the badger is not natural and instinctive; it is acquired, and the badger which turns lamb killer has acquired the taste through dead lambs having been left about. We need to bear in mind also that the badger is a lover of dense woodland surroundings. He does not favour open country, and will make a considerable detour by the hedgerows rather than cross an open field. Only in wild moorland localities does he venture much into the open, so that the normal badger in a normally wooded locality is exposed to very little temptation in the way of lamb killing.

I have studied the species closely for rather over twenty years, and have enjoyed, I suppose, exceptional opportunities for becoming conversant with its ways, but I have never come

across an instance of lamb killing or anything that suggested the least bent of character in that direction. Naturally I have met many close students of Brock at home, but I have known only two men who claim to have experience in which the badger's guilt was proved. The first was a passing acquaintance. The second was a rural sportsman with sixty years' experience, whose greatest desire was to see the badger given a fair deal, which hitherto the animal has never enjoyed, but he admitted rather grudgingly that well over forty years ago two badgers in his locality—where badgers have always been numerous—killed several lambs ere they were dug out and dispatched. When a beast, about which little is known—and no animal is more the victim of ignorance than the badger—commits a crime, the news of it spreads like bush fire, whereas the normal course of its life is hidden by the shadows we cannot penetrate.

Use of Badger Earths by Foxes.—There is no doubt whatever that foxes harbour better and do better where there are safe earth retreats for them than where there are none, and the badger earth forms the ideal retreat for foxes. This point was proved conclusively by the experiments and experiences of Sir Alfred Pease many years ago, as described in his book on the badger. "Had I had no badgers," says Sir Alfred, "I should have had no foxes." This has been proved over and over again within my own experience. In an agricultural country foxes harbour and remain everywhere that badgers exist, but when the badgers go the activities of the earth stopper slowly but surely causes the old burrows to fall out of use. Foxes cease to frequent the locality for breeding purposes, and naturally become fewer and fewer. Again, it has been found in other parts of the world that with the coming of settlement the foxes become extinct even before the jackals, except where badgers are plentiful. Here the foxes are able to hold their own indefinitely, thus adapting themselves to the changed order.

It is amply proved in every direction that the existence of the badger is beneficial to fox hunting, which makes it difficult to understand why so many huntsmen treat the animal with such disrespect. Badgers have, of course, been known to kill fox cubs, but when we ponder what Mrs. Brock has to put up with from her lodgers it is not to be wondered at that at times her slow-moving anger is roused, and she tries to rid herself of the pests. Still it may be taken that a hundred litters of foxes are afforded safe and ideal nursery quarters by the badger strongholds for every fox cub actually killed by badgers.

The Badger Harmless to Agriculture.—From the foregoing it will be seen that badgers need not enter into our reckonings at all as regards the safety of live stock of any kind, while as concerns hunting interests the presence of a few is undisputably beneficial. These are the two most important points as regards the affairs of those interested in agriculture, for the animal is entirely harmless in its food supplies.

In the Vosges mountains some of the peasants told me that the badgers, which were very numerous, had become destructive to their small holdings by rooting up their vegetable beds, being particularly partial to parsnips, but I have never heard of anything of this kind in Great Britain, where the badger, with his long bill of bitter memories, seeks and haunts only the least frequented hillsides and forest depths.

In Devon and in the Tweed valley I have heard complaints from farmers of the badgers treading down their crops at night time, the whole family assembling to sport and roll where the crops bordered the woodland edges.

The badger is, of course, a very ancient beast, and no wild creature that we have has been so much misunderstood and so unjustly treated. Where it exists any unaccountable occurrence which cannot at once be put down to fox or cat is laid at the door of the badger, for the reason that his ways are unknown, and he is punished accordingly. To me he stands out as the most pathetic figure in all our wild fauna—a lover of peace, seeking ever to avoid contingencies with man, living his retired woodland life on his own quiet lines. Yet glancing back through the history of sport, we find ourselves recommended to "cut away his lower jaw" or to "break off all his teeth" before entering our terriers to him! He is described as stinking and unclean, whereas no wild beast that we have is more free from odour and more cleanly in its way. Again, he has figured in the few of our fables into which he is entered as evil-tempered and morose, but of the many badgers that I have known in captivity all were docile, lovable beasts, and I have yet to know a badger which is one-half as aggressive as the average buck rabbit or jack hare.

THE ARTIFICIAL LIGHTING OF POULTRY HOUSES.

E. T. BROWN.

THE plan of artificially lighting the laying houses during the winter months is one that has been adopted by a considerable number of poultry-keepers, usually with excellent results. The system, however, being one that tends to force production, calls for careful application; otherwise more harm than good may be done. When care is exercised the results are extremely beneficial in all directions, but there is always a possibility that some poultry-keepers may go to extremes and consequently undo any good that would result.

The main object of lighting the laying houses for a definite period each twenty-four hours is to guarantee every day being of the same duration. Under normal conditions, the birds have less than eight hours of daylight on the shortest day; and during the period of great egg scarcity, that is, November, the days are not quite nine hours in length. It has been suggested that if a bird be inactive for more than ten consecutive hours out of the twenty-four the egg organs are interfered with and the yield is restricted. Whether this theory be correct or not has yet to be proved, but it is an undoubted fact that during the short days of winter heavy laying fowls have not sufficient time to eat and digest the necessary amount of food for the upkeep of their bodies and the formation of eggs. By feeding very highly concentrated and partially digested foods it might be possible to provide the bird's body, during the eight or nine working hours, with sufficient material for these purposes, but it has been found that the digestive system quickly becomes deranged when such a ration is fed. A certain quantity of bulky ingredients is essential to regulate the functions of the various organs concerned.

Methods of Lighting.—To secure the full benefit of this system it is necessary to illuminate the house brightly. The best form of artificial light that can be employed is electric light, but unfortunately this is not available in all cases. The next best is petrol-burning incandescent lamps. These are inexpensive to purchase, while they cost only about one-third of a penny per hour to burn. Acetylene may be used, but is not particularly good, besides being rather costly to instal. When electricity is the lighting agent, two 50-candle-power lamps

should be employed for each house, or section of a house, measuring 30 ft. by 14 ft. In addition, two dimmers—5-candle-power lamps are sufficient—are required. If a petrol burning hanging lamp be utilised, one is ample for the same area of floor space. For dimming purposes, two ordinary hurricane lamps can well be employed. There is no necessity to illuminate the whole of the house; the lamps can, therefore, be hung fairly close to the floor. The dimmers, however, should be placed directly over the roosts, so that the fowls will have sufficient light to reach their perches in safety. At the beginning of the laying season, the dimmers should be burnt for a quarter of an hour; in a few days, however, the birds will become so accustomed to the routine that they will all be roosting within four or five minutes after the main lights are switched off.

When to Light up.—Opinion is divided as to the best time to light the houses artificially. In some instances, when electric light is employed, the lights are automatically turned on at 5 a.m., and switched off at daylight. They are then lit up again at dusk and switched off at 7 p.m. Again, the house may be lighted as soon as it begins to grow dusk and the light turned out at such an hour as will give a twelve to fourteen hour day, without using artificial light in the morning. In the middle of October the sun rises about 6.20 a.m.; therefore the light should be kept burning until 8.20 p.m. Each night the time will get later, until on December 21st, when the sun rises a few minutes after 8 a.m., the artificial lighting would have to be continued until 10 p.m. A third plan, and one which has been found to give as good results as either of the two foregoing, is to allow the birds to go to roost in the normal way, lighting the house up at 7 p.m. and leaving it illuminated as long as necessary. If the first plan be adopted, the first feed of the day—the grain ration buried in the litter in the scratching shed—would have to be scattered at night, since under commercial conditions the length of the working day for the assistants should not be prolonged too much. The last feed would be given regularly about 5.30 p.m., as the lights would be turned off at 7 p.m. each day. When the houses are only lighted during the evening, the birds should be fed according to the usual plan; that is, the last feed should be given about 3.30 p.m. or 4 p.m. An additional light scratch feed must also be given to provide the birds with the extra nourishment they require for heavy production. In both of the two latter cases this is best given at 7 p.m. This scratch feed should not be looked upon in the light of a proper meal;

only a small quantity is necessary to supply the extra raw material needed for the formation of the eggs. The great advantage of making this last meal a scratch feed is that those birds which require the most food, that is, are laying the heaviest, will have an opportunity of securing sufficient. A pound and a half of grain is ample for 50 layers, no matter whether they be light or heavy breeds. This allows roughly ½ oz. per bird. The body requirements of heavy breed birds are, of course, greater than those of light breed birds, but this additional evening meal is intended only as a source of supply of raw material for egg production. The difference of the body needs is provided for by the slightly heavier rationing of the heavy breed birds during the day. Three parts of wheat and one part of kibbled maize make a suitable scratch feed for this meal.

The Results on Egg Production.—The chief result of artificially lighting the layers' houses is that winter egg production is increased very considerably. It is extremely difficult, at this stage, to give any definite statistics relative to the increase noted, since other factors may also contribute to the result. Even the reports which have been published concerning laying tests, in which a number of the flocks have been maintained under this system, do not help materially towards arriving at definite conclusions in figures. It is undoubted, however, that the rate of winter egg production is increased, but it appears to be equally correct that the total annual yield from the flock is in no way—or very slightly—influenced. If, however, it is possible to increase the winter yield by one-third greater when artificial light is employed than under normal conditions, as has been proved in some instances, and the profit from each member of the flock must be higher, since in the ordinary course of events these extra eggs would have been laid in the spring and early summer when the price is low. If the result be to increase the output from each layer by only 12 eggs during October, November and December—and this is a very low estimate—the difference between autumn and spring prices of eggs will give an extra gross profit of 2s. 9d. per bird.

The second result of importance to be noticed is that this system encourages the layers to pass into a short, light moult early in March. It is not suggested that all the layers will moult at his time, but those which have proved to be the heaviest layers generally comply with this rule. The duration of the moult, however, is only brief, not lasting more than four weeks at the outside. Some birds will continue to lay during

this period, although less regularly than earlier in the season, but this cannot be relied upon. This enforced rest instead of being a disadvantage is in reality a benefit. During this time the birds are able to recuperate after some months of very heavy production, and it is remarked that afterwards they lay at rather more than normal rate until the moult proper is due. In this way, although the total annual egg yield may not be increased, the eggs are produced at those periods when prices range higher than those obtained at the cheapest season of the year. It is for this reason that no attempt has been made to counteract the moult resulting from the use of artificial light. It should be possible to prevent the birds falling into this light moult in March, but in the opinion of the writer the rest is beneficial rather than otherwise.

It has been suggested that the use of artificial light in the laying houses tends to force production. This fact must be borne in mind and a beginning must not be made too early in October. If pullets which would not come into lay for two or three weeks under normal conditions are subjected to this process, the egg organs become active almost at once. Such an occurrence, however, should be avoided, since to encourage production unduly at this stage of a bird's life will probably stunt its growth, induce a continuance of the production of small eggs and in other ways injure it as a money-making machine. Pullets should only be passed into the illuminated laying house when they reach maturity and are ready to start work.

For the same reason the houses of the breeding pens should not be lighted. In this case it is desirable to secure a moderate number of strongly fertilised eggs rather than an increased number produced by forcing. It is quality not quantity that should be striven for. If breeders who sell eggs for hatching and day-old chicks attempt to force production in the breeding pens, they are not acting in the best interests of their customers; hence artificial lighting should not be employed.

Conclusions.—The success of this system, as a means of increasing the winter production of eggs, depends largely upon the quality of the stock which are subjected to it. To withstand successfully the undoubtedly baneful effects of forcing methods, the birds must be possessed of perfect health, a high standard of vigour, unimpaired vitality, and be bred along right lines and fed and otherwise managed correctly. The digestive system of the bird must work proportionately at the same speed as the egg organs, and therefore particular care must be paid to the quality

and nature of the rations supplied. The limitation of the working hours of the day to a maximum of fourteen is essential; to increase the hours of light to fifteen or above is productive of inferior results, as is always found when extreme measures are adopted. When working with good quality stock, however, which are treated in the manner indicated above, the lengthened day proves distinctly beneficial both to the health of the flock and to the egg yield. The egg yield, although increased, is not by any means abnormal. The egg organs are not called upon to work any harder than they do naturally in the spring of the year when egg production is normally at its highest. The lengthened day simply allows the birds to eat the necessary quantity of extra food for the manufacture of their eggs and does not induce abnormality in any direction.

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SEPTEMBER ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Seed Wheat.—In preparation for the approaching sowing season, problems regarding wheat seed require consideration during the present month. If no question about change of variety be raised, the farmer has still to decide whether to sow seed grown on his own farm or to introduce new seed, and if the latter, whence to obtain it.

The practice of changing the seed every few years is widely adopted; it has been observed for centuries; and the view is held that the best sources from which to obtain new seed wheat are clay or chalk soils in early districts. The practice rests upon the belief that repeated cultivation of a variety under the same conditions causes it to degenerate or "run out," and in consequence to lose cropping power, quality and other characteristics such as earliness. It is open to question, however, whether frequent change of seed is an important factor in wheat production, apart from the possibility of the "new seed" being a better sample than the home-grown corn.

Degeneration, apart from mixing with other varieties such as may be introduced by the thrashing mill, does not normally occur in established sorts of wheat, as this plant is self-fertilised. A most exhaustive test on this point was conducted at Garforth (Leeds University Farm) in the years 1899-1913.

Squarehead Master wheat was grown successively for 15 years in comparison with new seed of the same variety and with once-grown seed. The results of the 14th and 15th years of the tests, which were typical of the whole, were as follows:—

Year.	*Seed.*	*Yields per acre.* *Grain (bus.)* Saleable.	Seconds.	Total.	*Straw.* (cwt.)	*Weight per bus.* lb.
1913	New.	49½	2	51½	42	62½
	2nd time grown.	47¾	1	48¾	40¼	62½
	15th " "	47¾	1½	49¼	38½	62½
1914	New.	30½	3	33½	32¼	60¼
	2nd time grown.	30	3½	33½	31	60¼
	14th " "	28	3¼	31¼	29½	60¼

Experiments on similar lines were conducted at Wye College farm in the years 1919 to 1922, using five varieties. The conclusion from these was:—" So far there is no evidence of deterioration in the home-grown seed. Taking the average of all the plots, the home-grown seed gives a slightly larger yield than the new seed." The home-grown seed was always very carefully dressed before sowing.

To test the influence, if any, of the district of origin of seed, the writer began a series of trials in Derbyshire in 1920. The results in a typical example from the 1921-2 trials may be quoted. The variety was Marshal Foch.

Plot.	*Source of seed.*	*Corn, bus. per acre.* Best.	Seconds.	Total.	*Straw.* Cwt. per acre.
1.	Home-grown.	44⅓	⅔	45	42
2.	Essex.	40⅓	⅔	41	37⅓
3.	Lincolnshire.	38	½	38½	35
4.	Scotland.	39⅔	1	40⅔	37⅓
5.	Home-grown.	42½	1	43½	42

The writer's conclusions from the Derbyshire trials are that the quality of the individual sample of seed is of more importance than its source. Seed wheat should be well matured, harvested under good conditions, and thoroughly dressed to remove small grains.

The question as to whether a change of seed is desirable depends upon the quality and dressing of the home product. The latter may have become considerably mixed with other varieties differing in class of grain and in date of maturity. In a given year the crop may have grown and ripened irregularly, become lodged, or been subjected to bad harvesting conditions. In late districts and with certain heavy yielding but slow maturing varieties, such as Iron and Iduna, the local seed may not be sufficiently well ripened and conditioned for re-sowing.

There is always some risk of the seed being infected with *Cladosporium* disease after a wet harvest, the result of which is a thin plant, liable to perish in the winter. Home-grown corn secured under such conditions should be subjected to a germination test before being adopted for seed.

In the year 1920-21, following the wet harvest of 1920 in Derbyshire, the writer observed some striking examples of the advantage of good new seed obtained from the southern counties. In one case the plant from home-grown seed completely died away in the winter, while an adjoining plot of new seed sown on the same day grew well and made a full crop.

Matted Pastures.—In the March issue of this *Journal* attention was called to the mechanical treatment of certain types of grassland that give little response to manurial dressings. A still less responsive type of pasture occupies large areas in the northern midlands, especially on coal measures clays, but also on light dry soils. On pastures of the type about to be described, basic slag may be applied in very heavy dressings without producing any visible effect, although on adjoining pastures slag may act like a charm.

The type of pasture in question is that in which there occurs a "mat" of dead but incompletely decayed fibrous matter between the soil and the green herbage. The dominant grass —clover is absent—is usually creeping bent, and the other herbage may be sorrel, bed-straw, yarrow and such other plants as are capable of enduring soil acidity. The bent grass forms a close sward; but the pasture is unpalatable, late and unproductive. In the matted condition such land has very little grazing value.

The treatment necessary to remove a mat, and thus prepare the way for the action of phosphatic dressings, depends on the thickness of the fibrous layer, which may be several inches. In mild cases, the following method answers well:—in autumn, apply lime and harrow vigorously; next spring apply a complete dressing of artificials; and in the following winter apply phosphates. The inclusion of nitrogen in the first dressing of artificials promotes decay of the mat, probably in the same way as does the use of nitrogenous compounds in the process of rotting straw into artificial yard manure. If the pasture can for one year be treated as a meadow—manured and mown—the initial improvement will be hastened; also the application of yard scrapings and similar earthy matter is beneficial. As

the mat rots away, white clover begins to appear and spread; and while the clover remains no mat will again form: an occasional dressing of slag, with potash, if necessary, will keep the clovers in possession of the ground.

Pastures covered with a thick mat require drastic treatment. Many such fields were broken up during the food production campaign (1917-19) and a great many of them failed to produce a crop in the second year, the blame being generally laid upon wireworm; the symptoms of lime-failure strongly resemble wireworm attack.

A thick mat cannot be got rid of within several years without the use of the plough; but it is not necessary to incur the risk of a succession of crop failures by putting the broken-up land through a rotation of crops before seeding down again. This was a lesson learnt from the food production campaign. Grass and clover seeds will "take" and establish themselves on the back of a flat furrow ploughed out of old matted pasture, provided that lime be applied some months previously and a suitable tilth be obtained. The use of wild white clover in the seeds mixture is of special importance in this case, while the application of phosphates conduces to its early establishment.

In August, 1920, a field of badly matted pasture in the Belper district was ploughed up for improvement in accordance with the above principles. It was limed and sown with rye in the following month and in the spring of 1921 slag was applied and a simple permanent mixture sown. The "seeds" came well: the rye was in due course harvested as a corn crop; and the young pasture, now in its third year, has every appearance of forming a good permanent turf.

Milk Recording.—Recording the milk yield of each cow in the herd is gradually gaining recognition as a considerable aid to the good management of a dairy farm. As yet, however, only about one farmer in twenty records his cows, and among those who do keep records there are many who derive little benefit from the practice. To realise fully the advantages of recording, the information afforded by the weighing sheets must be extracted and utilised to criticise the performance of of each cow and to serve as a guide in feeding and breeding.

Weekly weighings serve as an approximate indication of the productivity of each cow. Recording at each milking, however, gives valuable further information: it reports any sudden depression in the yield of a beast, thus leading to inquiry as

to the cause—ailment or bad milking; it also serves as a basis for correct rationing, which is most essential to economical milk production, especially in winter.

The milk and food-cost records of any herd become more interesting to the owner when they are compared with those of other similar herds, as by such comparisons important points in management may be brought out. In herd A, it may be observed, for instance, that good cows maintain their maximum yield of 4, 5 or more gallons per day for a considerably longer period than do cows in herd B, which fall off in yield rapidly after about their eighth week of lactation. The owner of herd B, probably does not give his " flush " cows their proper share of the concentrated foods fed.

The more progressive milk recording societies play an important part in directing attention to the value of correct rationing. So far as the writer is aware, however, no society takes into account the quantity and cost of the nutriment consumed by the various herds entered in the herd competitions organised by such society.

The cost of being a member of a milk recording society varies from 3s. to 5s. per cow per annum. The next recording year begins on 1st October.

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MONTHLY NOTES ON FEEDING STUFFS.

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Scientific Feeding Standards and Feeding Practice.—The feeding of stock has always been acknowledged to be one of the most interesting features of agricultural practice, since the condition of a farmer's stock reflects more than anything else on the farm his capacity to farm successfully. The stockfeeder prides himself upon his ability to produce economically a beast that suits the local market, and he knows that that pride is not misplaced when the local butcher begins almost to haunt the farm in his anxiety to purchase some fat stock. Methods of feeding stock vary considerably from district to district, and it is evident that local conditions determine to a large extent the feeding methods adopted. Thus, in the eastern counties it is not uncommon for stock to consume daily up to $1\frac{1}{2}$ cwt. of roots per head. In the midlands, on the other hand, the writer has met very successful stockfeeders who have told him that it is unsound practice to feed more than 35 lb. of roots

a day. In the south-eastern counties, again, it is held that the maximum amount of roots that can be fed with economy is 75 lb. per day. Now, just as the housewife treasures up in a commonplace book recipes of table dainties culled from many sources, so the stockfeeder treasures up recipes of mixtures and methods of feeding that he and his forbears have found to be successful. While such methods are of value, the extent of their application to general practice is necessarily limited, and such stockfeeders find themselves on unsafe ground the moment questions of cost compel them to depart from their well-tried mixtures and experiment with unfamiliar but cheaper feeding stuffs.

It is at this point that the scientist is of value. The scientist has endeavoured to establish a quantitative relationship between the amount of food given to an animal and the effect that food will produce, whether in the form of meat, milk, or work. This problem has received consideration from the scientific investigator for nearly a hundred years, and it can be stated with confidence that, although the problem is not solved in all its aspects, sufficient is known to be of real service to the stockfeeder. The results of such investigations have been translated into scientific feeding standards, and such standards are used by many stockfeeders in this country. Hitherto, stockfeeders have chiefly made use of standards of rationing for dairy cows, the standards for fattening stock having proved too unwieldy and inelastic to be of general application to ordinary feeding practice. The trouble hitherto has been that the stockfeeder is feeding for a definite object which will vary with local conditions and local markets, and a fixed feeding standard is therefore inapplicable. Professor T. B. Wood, whose name is familiar to all stockfeeders, has devoted much time and energy to the solution of this problem, and in his book* has evolved a method of computing rations according to the result which the feeder desires to produce. Professor Wood has kindly promised the writer that he will outline, in future issues of these Notes, the methods whereby stockfeeders can compute the rations they should feed to produce economically the result they wish to attain.

Farm Values of Home-Grown Feeding Stuffs.—A correspondent has inquired as to the method of arriving at the price per lb. starch equivalent of the home-grown feeding stuffs given in the table, and what is meant precisely by value per ton on farm, since he finds no apparent relation between such

* Animal Nutrition, T. B. Wood, F.R.S., Univ. Tutorial Press.

DESCRIPTION.	Price per Qr. s. d.	Price per Qr. lb.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	—	—	13/6	13 10	0 15	12 15	71·6	3/7	1·92
Barley, Canadian, No. 3 Western	42/–	400	11/9	11 15	0 12	11 3	71	3/2	1·70
„ Karachi	41/6	„	11/7	11 12	0 12	11 0	71	3/1	1·65
„ Russian	41/6	„	11/7	11 12	0 12	11 0	71	3/1	1·65
Oats, English, White	—	—	10/8	10 13	0 13	10 0	59·5	3/4	1·78
„ Canadian:—									
No. 2 Western	30/9	320	10/9	10 15	0 13	10 2	59·5	3/5	1·83
No. 3 „	29/9	„	10/5	10 8	0 13	9 15	59·5	3/3	1·74
Feed	28/3	„	9/11	9 18	0 13	9 5	59·5	3/1	1·65
„ Argentine	26/–	„	9/1	9 2	0 13	8 9	59·5	2/10	1·52
„ Chilian	25/6	„	8/11	8 18†	0 13	8 5	59·5	2/9	1·47
Maize, Argentine	41/–	480	9/7	9 12	0 13	8 19	81	2/2	1·16
Beans, Rangoon	—	—	11/–	11 0†	1 11	9 9	67	2/10	1·52
Peas, Japanese	—	—	21/–	21 0†	1 7	19 13	69	5/8	3·04
Millers' Offals:—									
Bran, British	—	—	—	7 2	1 6	5 16	45	2/7	1·38
„ Broad	—	—	—	8 2	1 6	6 16	45	3/–	1·61
Middlings—									
Coarse, British	—	—	—	9 12	1 1	8 11	64	2/8	1·43
Pollards, Imported	—	—	—	7 17†	1 6	6 11	60	2/2	1·16
Meal, Barley	—	—	—	12 15	0 12	12 3	71	3/5	1·83
„ Maize	—	—	—	10 15	0 13	10 2	81	2/6	1·34
„ „ Germ	—	—	—	10 5	0 18	9 7	85·3	2/2	1·16
„ „ Gluten Feed	—	—	—	9 12	1 6	8 6	75·6	2/2	1·16
„ Locust Bean	—	—	—	9 0	0 9	8 11	71·4	2/5	1·29
„ Bean	—	—	—	13 0	1 11	11 9	67	3/5	1·83
„ Fish	—	—	—	18 10	4 3	14 7	53	5/5	2·90
Linseed	—	—	—	22 17	1 10	21 7	119	3/7	1·92
„ Cake, English 12% Oil	—	—	—	14 15	1 17	12 18	74	3/6	1·87
„ „ 10% Oil	—	—	—	14 2	1 17	12 5	74	3/4	1·78
„ „ 9% Oil	—	—	—	14 0	1 17	12 3	74	3/3	1·74
Cottonseed Cake, English 5½% Oil	—	—	—	8 15	1 13	7 2	42	3/5	1·83
„ „ Egyptian 5½% Oil	—	—	—	8 10	1 13	6 17	42	3/3	1·74
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 2†	2 12	10 10	71	3/–	1·61
Palm Kernel Cake 6% Oil	—	—	—	8 15	1 2	7 13	75	2/–	1·07
„ „ Meal 2% Oil	—	—	—	7 15	1 3	6 12	71·3	1/10	0·98
Feeding Treacle	—	—	—	8 2	0 8	7 14	51	3/–	1·61
Brewers' Grains:—									
Dried Ale	—	—	—	8 7	1 3	7 4	49	3/–	1·61
„ Porter	—	—	—	8 0	1 3	6 17	49	2/10	1·52
Wet Ale	—	—	—	1 5	0 9	0 16	15	1/1	0·58
„ Porter	—	—	—	0 19	0 9	0 10	15	–/8	0·6
Malt Culms	—	—	—	8 0†	1 13	6 7	43	3/–	1·61

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 12s. 5d.; P_2O_5, 4s.; K_2O, 2s. 6d.

value per ton and the market price of that commodity. Nor apparently is there any relation between this value per ton and the cost of production, nor even the valuer's "consuming value." The object of this table is to give farmers a price value per ton of home-produced feeding stuffs. This price represents the value of this commodity per ton *if consumed on the farm* as compared with the value of a similar number of units of starch equivalent purchasable in the open market. Thus, if the farm value of potatoes per ton is given as £2 19s. 0d. it means that the same amount of feeding value as a ton of potatoes contains can be purchased in the open market in the form of maize for £2 19s. 0d. The figure is of value in two ways. Firstly, if the cost of production per ton of potatoes is known, the farmer will know whether he is producing this feeding stuff at a cheaper rate than he can buy feeding stuffs in the open market, and, secondly, if he cannot sell his potatoes for more than the feeding value given it will pay him better to feed them to his stock since he cannot buy their feeding value more cheaply in open market. On the other hand, if he can get, say, £4 per ton for his potatoes sold off the farm he will obviously be making a profit by selling and buying in an equivalent amount of feeding value, say, in the form of maize at the price quoted in the table.

The price per lb. S.E. (starch equivalent) in column 1 is the price per lb. of S.E. of a food of comparable value given in the Market Prices table. Thus, for potatoes and roots, maize is taken as a basis of comparison; for hay, dried brewers' grains; and for silage, an average between these two figures. It is not claimed that this basis of comparison is scientifically correct, but it is felt that the basis comparison used is sufficiently accurate to be of value in assessing the price of the feeding values of home-produced foods.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm £ s.
Wheat	1·16	2 2	71·6	7 15	0 15	7 0
Oats	1·16	2 2	59·5	6 9	0 13	5 16
Barley	1·16	2 2	71·0	7 14	0 12	7 2
Potatoes	1·16	2 2	18·0	1 19	0 3	1 16
Swedes	1·16	2 2	7·0	0 15	0 2	0 13
Mangolds	1·16	2 2	6·0	0 13	0 3	0 10
Good Meadow Hay	1·61	3 0	31·0	4 13	0 13	4 0
Good Oat Straw	1·61	3 0	17·0	2 11	0 6	2 5
Good Clover Hay	1·61	3 0	32·0	4 16	1 0	3 16
Vetch and Oat Silage	1·39	2 7	14·0	1 16	0 7	1 9

PRICES OF ARTIFICIAL MANURES.

OTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending August 20th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	...	13.12	13.12	17. 7
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	12.17*	12.17*	12.17*	12.17*	(N)12. 5
„ „ „ neutral (N. 21.1 per cent.)	14. 0*	14. 0*	14. 0*	14. 0*	(N)13. 3
Kainit (Pot. 12½ per cent.)	...	...	...	2. 2	3. 5
French Kainit (Pot. 14 per cent.)	2.10	2. 3	2. 5	2. 5	3. 3
„ „ (Pot. 20 per cent.)	...	2. 7	...	2.10	2. 6
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.10	2. 7	2. 4
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	6.15	7.10	6. 7	2. 7
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11. 0	4. 7
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15	3. 5	1.10
„ (S.P. 30 per cent.) ...	3.16	3. 7	3. 8	2.19	1.11
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.10	8.10	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	6.10†	6. 0	6. 5†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ..	...	...	...	13. 0	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named.

* * * * * *

The Recognised Grades of Milk.

THE following grades of milk are recognised under the Milk and Dairies (Amendment) Act, 1922:—(1) "Certified," (2) "Grade A Tuberculin Tested," (3) "Grade A," and (4) "Pasteurised." There is also ordinary milk (ungraded) for which the price ruling for "milk" at the moment has to be paid. The first and most expensive class of milk is Certified Milk, which is obtained from special dairy herds which are under regular veterinary inspection, and which are found not to react to the tuberculin test. This milk must be bottled on the farm, must be sold in the raw (*i.e.*, unpasteurised) state. and must not contain more than 30,000 bacteria to one cubic centimetre, or show the presence of *Bacillus Coli* in one-tenth cubic centimetre on delivery to the customer. It is obtainable

from most milk retailers, though it can only be produced on a farm for sale as Certified Milk if a licence has first been obtained from the Ministry of Health.

The second class of milk—" Grade A Tuberculin Tested "—is produced from cows which are subject to veterinary inspection and do not react to the tuberculin test. It must also be sold in the raw state. It differs from Certified Milk in that it may be sent by rail in sealed churns to be bottled at the dealer's premises, and must not contain more than 200,000 bacteria per cubic centimetre and *Bacillus Coli* must not be present in one-hundredth of a cubic centimetre on delivery to the consumer. A licence for its production is also obtainable from the Ministry of Health.

Plain " Grade A " milk is produced from cows which are also subject to veterinary inspection; it may be sent by rail in sealed vessels to be bottled on the dealer's premises, and may be sold either in the raw state as " Grade A " milk, or after pasteurisation as " Grade A Milk Pasteurised." If it is sold in the raw state it must not contain more than 200,000 bacteria per one cubic centimetre, or show the presence of *Bacillus Coli* in one-hundredth of a cubic centimetre on delivery to the consumer. If it is sold as " Grade A Milk Pasteurised " it must be retained at a temperature of not less than 145 degrees F., and not more than 150 degrees F., for at least 30 minutes, and must then be immediately cooled to a temperature of not more than 55 degrees F. Such milk must not contain more than 30,000 bacteria per one cubic centimetre, and must not show the presence of *Bacillus Coli* in one-tenth of a cubic centimetre on delivery to the consumer. Licences for its production can be obtained from the local authority.

" Pasteurised Milk " is milk which has been pasteurised under certain specified conditions, and must contain not more than 100,000 bacteria per one cubic centimetre. The milk must not be pasteurised more than once and must not otherwise be treated by heat. Licences to produce this milk can also be obtained from the local authority.

* * * * * *

Poultry and Pig Conferences.

A POULTRY conference is to be held at the Midland Agricultural and Dairy College, Sutton-Bonington, Loughborough, on 23rd September, and it is hoped that the following will take part:—

Dr. F. A. E. Crew, Director, Animal Breeding Research Department, Edinburgh University—"Some Breeding Problems."

Captain J. P. Rice, B.Sc., Head of the Division of Animal Diseases, Stormont, Belfast—"The Prevention of Poultry Diseases."

Captain N. Bisset, Veterinary Adviser, Cardiff University—"Disease Problems."

A pig conference will be held at the college on 25th September, when discussion will be opened by the following:—

W. A. Stewart, M.A., Principal, Moulton Farm Institute, Northampton—"The Bacon Pig and Breeding for Bacon."

Dr. Charles Crowther, Principal, Harper Adams Agricultural College, Newport, Salop—"The Feeding of Pigs."

Dr. A. G. Ruston, Lecturer in Economics, Agricultural Department, The University, Leeds—"The Case for a Bacon Factory."

The Chief Organiser of the Agricultural Organisation Society—"The Financial Organisation of a Bacon Factory."

B. E. Brighton, The Co-operative Bacon Factory, Ruskington, Lincs.—"The Farm and the Factory."

* * * * * *

Special Grants for Agricultural Research.

THE Ministry of Agriculture has, with the concurrence of the Development Commissioners and the Treasury, made the following awards of special grants in aid of agricultural research into specific problems during the academic year 1924-25:—

Institution.	*Subject.*	*Amount of Grant.* £
University College of Wales, Aberystwyth	Nutritive Value of Grasses	250
Do.	Marketing in Breconshire ...	150
University College of North Wales, Bangor	Dry Rot of Swedes ...	165
Do.	Measurement of Evaporation and Drainage	62
Do.	Intestinal Parasites of Sheep	190
Imperial College of Science and Technology...	Change of Seed in Potatoes	60
Do.	Mosaic Disease of Hops ...	160
Leeds University	Colour of Wensleydale Sheep	200
Do.	Potato Disease (Internal Rust Spot)	220
Midland Agricultural and Dairy College	Solids-not-fat Contents of Milk	250
South Eastern Agricultural College, Wye	Flea Beetles	200
East Malling Research Station	Raspberry Diseases ...	250
London School of Economics ...	Crop Returns and Prices during the 13th, 14th and 15th centuries	125
University College, Reading ...	Soil Survey of Berkshire ...	100
University College, London ...	Control of Sex Proportion in Mammals	150
School of Agriculture, Cambridge	Soil Moisture and Air Earth Currents	265
[Institute not settled]	Eel Worm in Potatoes ...	250
		£3,047

Agricultural Returns, England and Wales, 1924.

THE preliminary tabulation of the Agricultural Returns collected on 4th June, 1924, in respect of agricultural holdings above one acre in England and Wales shows that the total area under crops and grass is 25,873,000 acres, comprising 10,928,000 acres of arable land and 14,945,000 acres of permanent grass. The total area of crops and grass is 70,000 acres less than the area returned in 1923, while the area of rough grazings has increased by 56,000 acres; the total area of land coming within the scope of the Returns is thus 14,000 acres less than in 1923. As regards livestock, the decline in the number of horses continues, but all other classes again show an increase, the rise in the case of pigs being remarkable.

As compared with 1923, the arable area has fallen by 253,000 acres, and permanent grass has increased by 183,000 acres. The area of arable land is now practically the same as in 1914.

Cereals.—The area under wheat again shows a substantial decline, and this year's decrease of 194,000 acres brings the area of this crop to the lowest figure since 1904. Part of the reduction this year is probably attributable to the very unfavourable weather conditions at seeding time last autumn. Barley shows a relatively small decline of 11,000 acres, while oats and mixed corn have increased by 57,000 and 18,000 acres respectively. The total area of the three chief cereals, including mixed corn, is 5,032,000 acres, this being 130,000 acres less than in 1923.

Beans and Peas.—These crops, the area of which fell substantially last year, show some recovery, beans having increased by 6,000 and peas by 30,000 acres; the latter is now well above the average, but the area of beans is still below the figures recorded in many recent years.

Potatoes.—The area of potatoes, which fell heavily last year, shows a further decline of 15,000 acres, small decreases being fairly general throughout the country, though none of the principal potato-growing districts show any marked change.

Roots.—The area under turnips and swedes has on the whole shown a downward trend for many years past, and with a reduction of 30,000 acres, the area of 832,000 acres this year is the lowest on record with the exception of that of 1922. The area of mangolds at 390,000 acres, shows a decline of 13,000 acres, and this year's acreage is rather under the average.

Fruit.—The area of orchards is returned at 239,000 acres, this being an increase of 7,000 acres over last year's area.

Small fruit at 73,000 acres shows an increase of 10,000 acres, nearly every county having a larger area this year, but it is doubtful if the whole of this is a genuine increase as there is some reason to suppose that growers last year did not in all cases make a full return of the small fruit grown under the trees in :hards.

Other .rops.—The area of other crops on the whole has increased, the only marked reductions being 10,000 acres in the case of rape, and 3,500 acres in that of linseed. Vetches or tares, with an increase of 25,000 acres has recovered a large part of the reduction of 49,000 acres recorded last year. The area of sugar beet shows a notable increase this year of nearly 6,000 acres, and the area under hops has been increased by over 1,000 acres.

Clover and Rotation Grasses.—The area of clover and rotation grasses which was increased by nearly 300,000 acres last year has now been reduced by 52,000 acres, and this year's total of 2,548,000 acres is practically the same as in 1921. The area reserved for hay is returned at 1,751,000 acres, this being 64,000 acres less than in 1923. The area of permanent grass for mowing is returned at 4,502,000 acres, or 145,000 acres more than last year, and the total area reserved for hay thus shows a net increase of 81,000 acres.

Horses.—The decline in the number of horses on agricultural holdings continues, the total of 1,232,000 returned this year being nearly 50,000 less than in 1923.

Cattle.—The total number of cattle returned is 5,893,000, an increase of 70,000 on last year's total. The number of cows and heifers in milk or in calf is 2,663,000, this exceeding last year's record figure by 48,000. There is a notable increase this year of 78,000 in the number of calves.

Sheep.—The total number of sheep this year is returned at 14,843,000, an increase on last year's total of over a million, the increase being about equally divided between ewes for breeding and lambs, the number of other sheep showing relatively little change.

Pigs.—The total number of pigs is returned at 3,227,000, this being the first time the three million mark has been reached. The increase on last year's total is no less than 615,000. The number of sows for breeding at 449,000 is also the largest recorded since this class was first distinguished separately in these Returns in 1893.

PRELIMINARY STATEMENT of Acreage under CROPS and GRASS.

DISTRIBUTION.	1924.	1923.	INCREASE.		DECREASE.	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL ACREAGE under all CROPS and GRASS	25 873.000	25,943,000	—	—	70,000	0·3
*ROUGH GRAZINGS	4.938,000	4,882,000	56,000	1·1	—	—
ARABLE LAND	10 928.000	11,181,000	—	—	253,000	2·3
PERMANENT GRASS — For Hay ..	4,502.000	4,357,000	145,000	3·3	—	—
PERMANENT GRASS — Not for Hay ..	10 443 000	10,405,000	38,000	0·4	—	—
PERMANENT GRASS — TOTAL ..	14 945.000	14,762,000	183,900	1·2	—	—
Wheat	1,546 000	1,740,000	—	—	194,000	11·1
Barley	1.316.000	1,327,000	—	—	11,000	0·8
Oats	2.035 000	1,978,000	57,000	2·9	—	—
Mixed Corn	135.100	116,800	18,300	15·7	—	—
Rye	59.100	73,200	—	—	14,100	19·3
Beans	241.300	†235,000	6,300	2 7	—	—
Peas	171.500	†141,400	30,100	21·3	—	—
Potatoes	451.800	466,700	—	—	14,900	3·2
Turnips and Swedes	831.800	862,000	—	—	30,200	3·5
Mangold	389.600	402,900	—	—	13,300	3·3
Cabbage, Savoys and Kale	80.100	72,200	7,900	10 9	—	—
Kohl-rabi	14.700	12,600	2 100	16·7	—	—
Rape	68.100	78,000	—	—	9,900	12·7
Vetches or Tares	112.200	86,900	25,300	29·1	—	—
Lucerne	64.400	57,900	6,500	11·2	—	—
Mustard for Seed	35.900	31,200	4,700	15·1	—	—
Brussels Sprouts	20.700	16,900	3,800	22·5	—	—
Cauliflower or Broccoli	12.400	11,100	1,300	11·7	—	—
Carrots	10.700	10,100	600	5·9	—	—
Onions	2.900	2,400	500	20·8	—	—
Sugar Beet	22.800	16,900	5,900	34·9	—	—
Linseed	5.200	3,800	—	—	3,600	40·9
Hops	26 000	24,900	1,100	4·4	—	—
Small Fruit	73.500	63,700	9,800	15·4	—	—
Orchards	239.200	232,100	7,100	3·1	—	—
CLOVER and ROTATION GRASSES — For Hay ..	1,751.000	1,815,000	—	—	64,000	3·5
CLOVER and ROTATION GRASSES — Not for Hay	797.000	785,000	12,000	1·5	—	—
CLOVER and ROTATION GRASSES — TOTAL ..	2.548.000	2,600,000	—	—	52,000	2·0
BARE FALLOW	355.600	435,600	—	—	80,000	18·4

PRELIMINARY STATEMENT of Numbers of LIVE STOCK in England and Wales on 4th June, 1924.

	No.	*No.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*
Horses used for Agricultural purposes (including Mares for Breeding)	782.300	798,100	—	—	15,800	2·0
Unbroken Horses (including Stallions) — One year and above	182.300	206,900	—	—	24,600	11·9
Unbroken Horses (including Stallions) — Under one year ..	54.700	66,300	—	—	11,600	17·5
Other Horses	212.900	210,000	2,900	1·4	—	—
TOTAL OF HORSES	1.232.200	1,281,300	—	—	49,100	3·8
Cows and Heifers in Milk	2 013.900	1,974,600	39,300	2 0	—	—
Cows in Calf, but not in Milk	281.500	269,000	12,500	4·6	—	—
Heifers in Calf	367.300	371,200	—	—	3,900	1·1
Other Cattle :—Two years and above ..	987,000	1,018,500	—	—	31,500	3·1
,, ,, One year and under two	1.084.100	1,108,200	—	—	24,100	2·2
,, ,, Under one year.. ..	1.159.700	1,081,500	78,200	7·2	—	—
TOTAL OF CATTLE	5.893 500	5,823,000	70,500	1·2	—	—
Ewes kept for Breeding..	5 989.800	5,505,200	484,600	8·8	—	—
Other Sheep :—One year and above ..	2.576.800	2,524,700	52,100	2·1	—	—
,, ,, Under one year	6.276.400	5,805,600	470,800	8·1	—	—
TOTAL OF SHEEP	14 843.000	13,835,500	1,007,500	7·3	—	—
Sows kept for Breeding	448.800	388.500	60,300	15·5	—	—
Other Pigs..	2.778.300	2,223,100	555,200	25·0	—	—
TOTAL OF PIGS	3.227.100	2,611,600	615,500	23·6	—	—

* Mountain, Heath, Moor, Down and other rough land used for grazing.
† In addition there were 4,900 acres of beans and peas grown for fodder in 1923.
The area grown for fodder in 1924 has not been separately distinguished in the Returns.

The Agricultural Index Number.

THE index number of prices of agricultural produce in England and Wales shows a fall of no less than 6 points this month, prices during July being on the average 52 per cent. above those in the corresponding month in the years 1911 to 1913. During May and June a rise occurred, and the general level of prices in the latter month was decidedly higher than last year, but the present reduction brings the figures again to approximately the same level as a year earlier.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Potatoes are the main cause of this month's fall, First Early potatoes, at an average of about £10 per ton, being in July only 81 per cent. dearer than in the corresponding month in the basic years. This figure is still high in comparison with those for most other kinds of agricultural produce, and is 15 points higher than in July last year, but it shows a very heavy fall from the figures of 219 and 174 per cent. above pre-war prices recorded in May and June respectively.

The reduction in potato prices is in itself nearly sufficient to account for the whole of the fall of 6 points shown by the general index number, and changes in other kinds of produce, although in some cases considerable, on the whole about balance. Wheat and barley both show advances, amounting to 5 and 4 points respectively, but oats are slightly lower; it must be remembered, however, that the prices for these cereals are based upon extremely small sales, and the producer has thus gained very little from the advance.

Fat cattle are somewhat cheaper, and pigs, in spite of a slight rise in price, show no change, owing to a similar rise between June and July in the years 1911 to 1913, but sheep show a further advance and averaged over the month very nearly double

their price in the corresponding month in the pre-war years. Since March of this year sheep have gained no less than 38 points, but it is noticeable that prices have actually advanced only ¾d. per lb., the rise being chiefly attributable to the fact that between March and July in the basic years sheep fell from 8¾d. to 7¼d. per lb.

Store cattle fell slightly in July, as is usual at this time of the year, but the fall was much less marked than in pre-war years, and the index number shows a rise of 4 points. Store sheep also show an advance, for the third successive month, although July prices were actually decidedly lower than those of May and June. but store pigs have continued the decline which has been uninterrupted for over a year, and are now only 28 per cent. above pre-war prices.

Eggs at an average of 1s. 7½d. per dozen, showed a much greater rise than usually occurs between June and July, and the index number has risen 22 points, but poultry is cheaper, although still relatively dear at about 80 per cent. above pre-war prices. Butter advanced decidedly, the increase of 2¾d. per lb. representing a rise of 17 points in the index number, and cheese also showed a rise for the third successive month, although in this case the rise is due to price changes in the basic years, as Cheddar cheese has remained practically unchanged at about 127s. to 128s. per cwt. at the wholesale markets since the beginning of the year.

Index numbers of different commodities during recent months and in May, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. July.	1924. Mar.	Apr.	May.	June.	July.
Wheat	39	46	38	38	42	47
Barley ...	12	45	48	46	48	52
Oats	41	39	35	30	32	28
Fat cattle ...	45	52	49	51	55	54
Fat sheep ...	72	64	75	87	93	97
Fat pigs .	54	33	35	32	31	31
Dairy cows ...	49	64	63	58	59	55
Store cattle ...	28	41	38	42	47	51
Store sheep ...	109	85	84	96	121	132
Store pigs ...	113	45	42	36	32	28
Eggs... ...	36	68	48	40	43	65
Poultry ...	79	59	70	87	93	80
Milk	57	71	58	50	50	50
Butter ...	37	63	51	40	43	60
Cheese ...	54	71	71	77	83	90
Potatoes ...	66	173	154	219	174	81
Hay	38	1	0	4	3	1

Acreage of Hops.

THE following Preliminary Statement compiled from the Returns collected on 4th June, 1924, shows the Acreage under Hops in each County of England in which Hops were grown in 1924, with a Comparative Statement for the Years 1923 and 1922:—

COUNTIES, &C.		1924.	1923.	1922.
		Acres.	Acres.	Acres.
KENT	East	3,660	3,540	4,100
	Mid	5,550	5,200	5,530
	Weald	6,870	6,720	7,110
	Total, Kent	16,080	15,460	16,740
HANTS		1,010	1,020	1.070
HEREFORD		4,100	3,890	3,950
SURREY		220	210	220
SUSSEX		2,390	2,260	2.350
WORCESTER		2,080	1,950	2,030
OTHER COUNTIES		100	100	90
Total		26,010	24,890	26,450

* * * * * *

Foot-and-Mouth Disease.—The number of outbreaks of foot-and-mouth disease confirmed each week still averages 18, the total for the four weeks ended 17th August being 74, as compared with 71 for the previous four weeks published in the August issue of the *Journal*. In the week ended 27th July, 20 outbreaks occurred (1 each in Derby, Kesteven (Lincs), Worcs, 2 each in Bucks, Notts, Staffs, 3 in Dorset and 8 in Oxford); in the week ended 3rd August, 18 outbreaks (1 each in Dorset and Worcs, 2 each in Kesteven (Lincs), and Wilts, 3 each in Bucks and Oxford and 6 in Kent); in the week ended 10th August, 15 outbreaks (1 in Notts, 3 each in Bucks and Kent, and 4 each in Oxford and Wilts); and in the week ended 17th August, 21 outbreaks (1 each in Hants, Lancs, Notts, 2 in Bucks, 3 in Oxford, 4 each in Kesteven (Lincs) and Wilts, and 5 in Kent).

It is satisfactory to report that there have been only two new centres of disease in connection with the above outbreaks, at Gerrard's Cross (Bucks), on the 21st July, and in the Liverpool district (Lancs) on 11th August. In both these cases the origin of the disease is quite obscure. On 5 occasions, however, it has been necessary to extend already existing infected areas in consequence of outbreaks near the borders of those areas.

The total number of outbreaks from 27th August, 1923, to 17th August, 1924, is 3,271, involving 43 counties in England, 2 in Wales, and 12 in Scotland. The number of animals slaughtered amounts to 108,984 cattle, 51,549 sheep, 49,529 pigs, and 129 goats, the gross compensation being £3,494,000 and the estimated salvage £533,000.

REPLIES TO CORRESPONDENTS.

Manuring of Grassland.—J.O. refers to turves exhibited at the Yorkshire Show, showing effect of basic slag on pasture land, and asks whether a yearly application of 5 cwt. of slag on strong clay, that has had half a ton of 24 grade slag three or four times in the last ten years, would be a waste of money.

Reply: It is somewhat difficult to give a categorical reply. Speaking generally, 5 cwt. of slag each year following the heavy dressings of the last ten years would be rather on the extravagant side, and it would probably be advisable to follow the recommendation in the middle of page 4 of Leaflet No. 267 (Basic Slag), and wait until there are indications that a further dressing of slag is required. The County Agricultural Organiser is being asked to give further advice.

Eradication of Rest-harrow.—K.P. asks for information as to any practicable method of eradicating a weed known as Cammock or Cummock.

Reply: Cammock or Cummock appears to be a local name for Rest-harrow (*Ononis arvensis* L.). Long, on page 163 of "Common Weeds of the Farm and Garden," states that this "is in some localities a very harmful pest in pastures on poor heavy land, and some forms of it also on dry sandy and gravelly soils." The weed is a perennial and "must be attacked if in quantity by manuring, regular cutting and close depasturing with stock; in bad cases it may be necessary to plough up the pasture, give a thorough cleaning and manuring, and again lay down to grass in the usual manner." General directions for the cutting of perennial weeds are given on page 5 of Leaflet No. 112; for more detailed advice it would be well to consult the County Organiser.

Yields of Wheat from Single Grains.—L.R. refers to a statement made by the Member for Rutherglen in the House of Commons on 3rd July to the effect that he had raised "not merely the usual 80 grains from one seed but 1,000 to 1,500," and asks for information.

Reply: From quite early times* there are records of such yields. Professor Percival, of Reading University, in his monograph on "The Wheat Plant" (1921) refers to a statement by Everard in 1692 "that he obtained from single grains sown 10 inches apart, plants which produced 60-80 ears, the largest of which contained 40-60 grains, the best plants yielding over 4,000 grains. Tull, in 1731, refers to plants with 40 ears. In 1870 C. H. Shirreff found in his garden a single plant bearing 80 ears which yielded 4,524 grains." Professor Percival states that he has had plants bearing 60-70 ears and over 2,500 grains. He remarks that "in all these examples the plants were grown on soils in a high state of fertility and had unrestricted space for their development," and adds that "the necessary space required to secure these highly productive plants is not known, but it is certain that it is vastly greater than 10 square inches, the space which is allotted to each grain when one bushel (650,000 grains) is sown on an acre."

He gives a table showing, in the case of Swan wheat, the yields

* *Note.*—An early reference is Pliny the Elder (died A.D. 79), who records (Nat. Hist., XVIII x 95) from Africa "just under 400 stalks of wheat from one seed" and "340 stalks from one seed."

obtained from grains sown in spaces varying from 6 to 24 square inches. This table shows the yields per single plant consistently increasing and the yields per acre consistently decreasing with the wider spacing. In the 24-square inch spaces the yield was 354 grains per plant but only 5.73 bushels per acre, while in the 6-square inch spaces though the number of grains per plant was only 43, the yield per acre was 43.15 bushels. And he concludes:—

"In spite of the fact that under special circumstances thin-sowing may succeed, in practice it is found to be less hazardous to attempt to obtain an adequate number of ears per acre by thick-sowing rather than by thin-sowing and its concomitant tillering, especially when the amount of seed sown is far removed from that ordinarily sown."

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Hertfordshire Institute of Agriculture.—Bulletin 3:—The Necessity of Lime or Chalk in Hertfordshire. (8 pp.) Oaklands, St. Albans, 1924. [63.15.]

Pennsylvania Agricultural Experiment Station.—Bulletin 175:—Forty Years' Results with Fertilizers. General Fertilizer Experiments. (23 pp.) Centre County, 1922. [63.16(04).]

Field Crops.

Reading University College and the Berkshire Agricultural Instruction Committee.—Bulletin 4:—Results of Field Trials on the Manuring of Mangels, 1923. (7 pp.) Reading, 1924. [63.332.]

Reading University College and the Berkshire Agricultural Instruction Committee.—Bulletin 6:—Result of a Field Trial on the Manuring of Swedes, 1923. (4 pp.) Reading, 1924. [63.332.]

Reading University College and the Berkshire Agricultural Instruction Committee.—Bulletin 5:—Results of Field Trials with Potatoes in Berkshire, 1923. (15 pp.) Reading, 1924. [63.512.]

Pennsylvania Agricultural Experiment Station.—Bulletin 187:—Soybeans: Their Culture and Uses. (15 pp.) Centre County, 1924. [63.321.]

South Australia Department of Agriculture.—Bulletin 181:—Subterranean Clover (*Trifolium subterraneum*). (15 pp.) Adelaide, 1924. [63.33(b).]

Missouri Agricultural Experiment Station.—Circular 121:—Inoculation for Legumes. (12 pp.) Columbia, 1924. [576.83.]

Horticulture and Fruit Growing.

Dyke, W.—The A.B.C. of Tomato Culture under Glass. (195 pp.) London: Lockwood Press, 1924, 2s. 6d. net. [63.513.]

Dyke, W.—Manures and Fertilisers incorporating formulæ by Dr. Griffiths for Special Manures for Garden and Greenhouse. (138 pp.) London: Collingridge, 1924, 4s. net. [63.16; 63.41; 63.5.]

Ohio Agricultural Experiment Station.—Bulletin 364:—The Strawberry: Its Culture and Varieties. (pp. 60-98.) Wooster, 1923. [63.41(c).]

Plant Pests and Diseases.

University College of North Wales.—Preliminary Report on the Agricultural Zoology of North Wales by *C. L. Walton.* (28 pp.) Bangor, 1924. [63.292(42); 59.169.]

U.S. Department of Agriculture.—Dept. Bulletin 1239:—Studies in the Physiology and Control of Bunt, or Stinking Smut, of Wheat. (29 pp.) Washington, 1924. [63.24.]

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NOTES FOR THE MONTH.

Land Drainage.

THE great importance of land drainage is widely recognised by farmers, who understand the general benefits which proper drainage brings in its train, while realising the loss which excessive moisture in the soil may cause. It may be that in the years immediately following the War the high cost of works of any description has led many farmers to defer drainage operations which, in their own interests, should have been carried out promptly and effectively. Be that as it may, it is undoubtedly true that there are extensive areas where, owing to obstruction of drains, dykes and other water courses, the level of the water-table may be said to be actually above ground for considerable periods. Where arable land is concerned such a condition commonly leads to a complete loss of crop during a rainy spell, and much loss of time and money in again preparing the land for re-sowing.

Grass is not so readily destroyed by inundation as are arable crops, though long-continued water-logging is obviously inimical to both. Nevertheless complete stagnation where grass land is involved leads to heavy losses in several directions. Cases could readily be cited in which not only has a prospective valuable hay crop been lost owing to flooding in the winter and early spring, but deposits of silt and rubbish have ruined the grazing for the season—and this may occur when grazing can ill be spared.

Another loss which has been far too common during the last few years relates to the drowning of many head of stock—horses, cattle and sheep—in areas adjoining the smaller water courses, where water meadows and their deep ditches occur, or where, as in the Fen districts, large dykes are essential to keep the surrounding arable land in workable condition. Freedom from obstruction of the drains, dykes and water courses

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would permit a much easier passage of flood water, and losses of stock would be reduced to a minimum which could be regarded as accidental.

Finally, there are losses due to the incidence of certain animal diseases which occur regularly and severely on marshy and badly-drained land, but which are much less frequent or almost negligible on well-drained, well-managed, "healthy" land.

Readers of this *Journal* are urged to give special attention to the articles in this issue at pp. 610 to 621.

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Report on Farm Settlements for ex-Service Men.

A REPORT by the Ministry of its Proceedings under the Small Holdings Colonies Acts, 1916 and 1918, and the Sailors and Soldiers (Gifts for Land Settlement) Act, 1916, covering the two years 1921-2 and 1922-3, will shortly be published by H.M. Stationery Office. The Report is of interest not only to County Councils and the Councils of County Boroughs acting in accordance with the powers conferred on them by the Small Holdings Act, 1908, and the Land Settlement (Facilities) Act, 1919, but to all who are interested in the settlement of ex-Service men on the land and the extension of small holdings in this country.

This Report is concerned with a small part only of the complete Scheme for the settlement of ex-Service men on the land, namely, the work of the Ministry itself, in settling ex-Service men on small holdings and profit-sharing farms by direct administration.

* * * * * *

Report on Allotments, 1923.

THE Ministry has just issued a Report on its work during the year 1923 under the Allotments Acts, 1908-1922.* The Report reviews the developments which have taken place in regard to allotments in England and Wales since the issue of the previous report on the subject in 1921, consequent upon the transfer from war-time to permanent legislation, which resulted in the appointment of the Departmental Committee on Allotments the passing of the Allotments Act, 1922, and the setting up of the National Advisory Committee.

Reference is also made to the further powers and duties of certain Allotment Authorities under the above Act, while other paragraphs deal with the administrative action of the Ministry

* Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, price 1s., post free 1s. 1½d.

in 1923 in connection with the confirmation of Orders made by Local Authorities for the compulsory acquisition of land for allotments, the confirmation of rules made under Section 28 of the Small Holdings and Allotments Act, 1908, and the exemption of certain Local Authorities from the requirement to establish an Allotments Committee under Section 14 of the Allotments Act, 1922.

A separate paragraph is devoted to the history of D.O.R.A. allotments, which were provided under the Cultivation of Lands Orders and ceased to exist as such at 25th March, 1923. Information is also given as to the number of plots provided, and the cost of the service to the State, together with an account of the effect of the scheme upon the allotments movement generally.

An appendix to the Report contains statistical information, compiled from returns furnished by the various allotment authorities, showing the acreage of allotment land in England and Wales and the number of allotment holders, together with particulars of the applications for allotments received by such authorities in 1923, and the approved unsatisfied demand for allotments at the end of the year.

* * * * * *

" All-English " Flour.

THE Bakers' and Confectioners' Exhibition recently held at the Royal Agricultural Hall has provided a splendid opportunity of testing the merits of " All-English " flour for bread-making. Its excellence for biscuit-making and for certain household purposes is well established and needs no confirmation: but for bread-making the full recognition of its qualities comes slowly. The demonstration at the Exhibition is therefore invaluable in so far as it shows that the English farmer has at his disposal varieties of wheat which have the necessary qualities for bread-making. It makes it perfectly clear to the baker that flour from improved varieties of home-grown wheats has all the strength and qualities for the making of a first-class loaf. It is hoped that this will give rise to an increased demand for this type of flour, which in its turn will lead farmers to cultivate these improved varieties to a larger extent. An obvious economy in transport charges alone can be secured by milling these wheats in the areas where they are grown, and this should be an inducement to millers to offer better prices to farmers. Apart from the use of " All-English " flour for making a purely British loaf, bakers might well increase the proportion of such

flour in their ordinary bread up to the limit of available supplies.

The great interest shown by the general public in the competition at the Bakers' Exhibition was very noticeable. When the loaves made from home-grown wheat flour were exhibited many comparisons were made between them and the ordinary loaf, to the disadvantage of the latter. To most people the soft almost creamy look of the home loaf presented much greater attraction than the hard whiteness of the other. The rate of extraction of the flour used was laid down as "not less than 70 per cent. of the cleaned wheat" and even with this relatively high percentage the loaves made showed an excellent and very even colour. The judges, in their report, remarked on the very decided improvement shown in the quality of the flours submitted this year, in spite of the fact that the seasons 1923 and 1924 were unfavourable to the crop through lack of sunshine and other conditions. Considering the nature of the present season it is interesting to note that the first prize in the two leading classes was gained by flour made partly from the 1924 crop of Yeoman.

* * * * * *

Stud Goat Scheme.

This Scheme, which was referred to in the June issue of the *Journal*, p. 291, is now in operation. Its object is to improve by means of breeding the productive quality of milch goats kept by small-holders, cottagers and other persons of similar standing. The Scheme is being conducted by the British Goat Society (Hon. Secretary, Mr. T. W. Palmer, 5, Fenchurch Street, London, E.C.3), and will be financially assisted by the Ministry. Selected stud goats are now available at a low fee (in no case exceeding 5s.) for the use of owners coming within the category mentioned. A list of the stud goats available during the current breeding season, which began on 1st September, has been supplied to each County Authority for agricultural education, who may usually be addressed at the County Offices.

The Scheme is open to all those who own female goats, whether members of the British Goat Society or not, provided they come within the category of the small-holder or cottager class. No stud goat has been approved which has not been personally inspected by a competent officer of the British Goat Society, and is of sufficiently high standard for inclusion in the Society's Herd Book, and the Ministry's Small Livestock Inspectors will visit the stud goat centres from time to time to

ascertain whether the regulations of the Scheme are being complied with.

It is hoped that small goat-keepers who wish to obtain female kids worth rearing will take full advantage of the facilities offered by the Scheme. The continuance of these facilities will depend to a large extent on the response made during the present goat breeding season by those persons for whose benefit the Scheme has been arranged.

Copies of the Ministry's Leaflets No. 383 (*Hints on Goat-keeping*), and No. 306 (*The Goat as a Source of Milk*), can be obtained on application to the Ministry, price 1d. each, post free, or, together with a list of the stud goats available under the Scheme, from the British Goat Society.

* * * * * *

The Production of Clean Milk.

THE increasing popularity of clean milk competitions shows that their educational value in improving the conditions of milk production is appreciated not only by the Agricultural Education Authorities but also by dairy farmers and their employees. It has been evident, however, that to obtain comparable results and to secure the full benefits from these tests, an endeavour should be made to co-ordinate and standardise the conditions under which they are held, and also the system of marking by which the results are determined. With this object in view the Ministry appointed a Committee some months ago to consider and draw up a set of model rules for conducting such competitions, together with an approved system for assessing marks to the competitors: and the results of the Committee's deliberations are now available in the form of a "Guide to the Conduct of Clean Milk Competitions."* This brochure lays down regulations for the conduct of competitions, the methods of taking milk samples, determining keeping qualities, making bacteriological examinations, assessing marks, etc., and it should be of great assistance to any body which is contemplating holding a competition. One of the most important facts emerging from the holding of competitions has been that success in the production of clean milk depends much more on the personal element and the methods employed than on expensive buildings and elaborate apparatus. Dairy farmers have found, sometimes to their surprise, that without such material facilities, the strict attention to routine work enjoined by participation in these

* Miscellaneous Publications, No. 43, obtainable from the Ministry's Office 10, Whitehall Place, London, S.W.1, price 1s. 6d. net, post free.

competitions has enabled them to produce milk of sufficiently high grade to qualify for the designated standards. This clearly illustrates the educational benefits derived from the competitions, which demonstrate that a high standard of cleanliness in milk production can be obtained without heavy capital expenditure on buildings and equipment.

* * * * * *

Instruction in the Grading and Packing of Fruit.

THE Ministry has recently established at Cottenham, Cambridgeshire, a temporary apple grading and packing station for the purpose of affording to fruit growers a demonstration of the possibilities of the co-operative grading, packing and marketing of apples in this country. The station is equipped with a Cutler Grader Machine and other equipment necessary for the grading and packing of apples on up-to-date methods.

In order to assist the horticultural staffs of county education authorities to give instruction to growers in modern methods of grading and packing apples, courses of instruction in this subject commenced at the station on 29th September and will continue until 18th October. The courses were open to both horticultural instructors and fruit growers, and an invitation to attend was circulated through the Press. (The last day for entries was 20th September.)

* * * * * *

Broadcasting Agricultural Information.

WITH reference to the note which appeared in the September issue of this *Journal*, p. 513, as to broadcasting agricultural information, it may now be added that a series of fortnightly wireless messages from the Ministry to farmers and others will commence on Friday, 3rd October. The messages will be made up at the Ministry on the morning of each alternate Friday and will be delivered through the wireless usually at about 6.45 p.m. the same evening by an officer of the British Broadcasting Company, in the same way as are the News and Weather Reports. It is expected that each message will take about fifteen minutes to read, and will contain, amongst other matter, information on current prices of the chief classes of agricultural produce and on market tendencies, observations upon the current seasonal agricultural operations—with appropriate reminders in regard to certain branches of farm work—and some general remarks from the Ministry on a special topic of interest selected for the week, *e.g.*, " The Choice of Seed

Corn." "Work upon an Allotment," "The Problem of Utilising Surplus Milk," etc. It is expected that the Minister of Agriculture, Mr. Noel Buxton, M.P., will introduce this series in a short address on 3rd October.

In addition, there will be delivered once a month an address by a well-known agricultural or other expert on a subject to be chosen by him. Sir John Russell (Director of the Rothamsted Experiment Station), Professor C. Crowther (Principal of Harper Adams Agricultural College), Professor Biffen (Cambridge University), Professor B. T. Barker (Bristol University), Dr. F. H. A. Marshall (Cambridge University), Mr. R. G. Hatton (East Malling Fruit Station), Professor Stapledon (Aberystwyth University), and, on the Ministry's own staff, Sir Daniel Hall (Chief Scientific Adviser) and Sir Stewart Stockman (Director of Animal Research) have already consented to give addresses.

* * * * * *

New Funds for Agricultural Education and Research.

THE Government has decided to provide a further sum of £500,000 for agricultural education and research in addition to the funds already available for that general object, amounting to £1,000,000, under the Corn Production Acts (Repeal) Act, 1921, and about £400,000 per annum from other Government funds. It has been arranged that this new money will be paid over to the Development Fund by the Treasury as required, and that it may be looked upon as provided for use during the next five years. No definite allocation as between Scotland on the one side and England and Wales on the other has been made.

The Ministry of Agriculture and Fisheries is framing proposals for the following schemes to be assisted from this new money:—(a) *Foot-and-Mouth Disease Research*—work already in progress; (b) *Economic Research*—scheme for testing new systems of farm management and for strengthening the staff of the Institute of Agricultural Economics at Oxford; (c) *Marketing Investigations*—work of Marketing Commissioner and six Marketing Officers already appointed; (d) *Veterinary Education and Research;* (e) *Agricultural Advisory Scheme*—to complete the existing advisory scheme by the appointment of additional scientific officers, and for a scheme to provide milk analysts at each of the agricultural colleges; (f) *Soil Surveys*—to provide for the extension of soil surveys which have hitherto been started only in certain particular areas; (g) *Additional Research Grants*—to meet the cost of further developments at existing Research Institutes

(increases of staff, etc.) beyond those hitherto contemplated; (h) *Vegetable Testing;* (i) *National Institute of Agricultural Botany*—to develop further the Institute's operations, particularly in regard to variety trials of field crops.

* * * * * *

The Agricultural Index Number.

PRICES of agricultural produce recovered during August from the pronounced fall recorded in the previous month, the general level of prices in August being 59 per cent. above the corresponding month in the years 1911 to 1913, as compared with the July level of 52 per cent. above pre-war. The August figure is the highest since March, 1923, with the exception of the first two months of this year, and is 5 points above the figure in the corresponding month last year.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	59
September	202	116	57	56	—
October ...	194	83	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

The decline of 6 points recorded by the index number for July was attributable almost wholly to the sharp fall in potato prices. This fall has continued, the average price in August being under £7 per ton, as compared with £10 per ton in July; but the decline is not much heavier proportionately than that which occurred between July and August before the war.

Both wheat and barley advanced substantially during August, averaging 12s. 9d. and 13s. 3d. respectively per cwt., against 11s. 11d. and 11s. 5d. respectively in July, the corresponding index numbers advancing by 12 and 23 points. Oats show a small decline in price from 9s. 10d. to 9s. 8d. per cwt., but, owing to a much greater decline between July and August in the basic years, the index number has risen 10 points on the month. Wheat is now at about the average level of all produce, for the first month since July, 1921, while barley is decidedly above the general average and is second only to fat sheep among the chief agricultural products sold off farms.

As in the case of cereals, the index numbers of prices of fat stock all show a rise during August, although the advance amounts to only two or three points in each case. Fat cattle were, in fact, a shade cheaper on the month, but the decline is seasonal and is less pronounced than in pre-war days. Both sheep and pigs rose, the latter appreciably, but here again the price movement is seasonal and the index number is hence less affected than the actual price change would indicate.

Store stock show little change on the month. Dairy cows advanced by about 14s. per head, averaging £32 5s., and the index number rose two points, but cattle and sheep declined slightly, while pigs remained practically unchanged. The increasing attention which farmers are paying to sheep is shown by the fact that store sheep continue to realise considerably more than double their pre-war price.

Milk shows an advance of 8 points on the month, due to the higher prices paid under contract for milk delivered to the Manchester district during August as compared with May, June and July. Butter has also advanced, but cheese is cheaper on the month, due mainly to the fact that considerable quantities of new cheese have now reached the markets. Both poultry and eggs show reductions on the month, substantial in the case of the former, but the slight decline in the case of eggs is due to the seasonal advance in the basic years being relatively greater than this year, as the average price actually rose from 1s. 7½d. to 1s. 9½d. per dozen between July and August this year.

Hay, both clover and meadow, was fractionally cheaper during August than during the previous month, but here again the seasonal change in the basic years was greater than during the current year, and the index number shows a slight rise.

It will be seen, therefore, that the marked recovery shown by the index number for August is the result of a general rise all round, the only commodities failing to show an advance being poultry, eggs, potatoes and cheese. In some cases the advance is due not to an actual increase in price, but to a seasonal decline less severe than occurred in the basic years 1911 to 1913. A seasonal decline of less than the normal proportion, however, is still a gain to the farmer, and there is no doubt that the advance of 7 points recorded by the index number represents a definite improvement, on the average; in farming receipts, however, this may be off-set by an equal or greater advance in costs of production.

LAND DRAINAGE SCHEMES: BENEFICIAL RESULTS OF STATE ASSISTANCE.

(BEING AN ACCOUNT OF LAND DRAINAGE WORKS FOR THE RELIEF OF UNEMPLOYMENT, 1923-24.)

FOR the past three winters, the Ministry has been enabled by Parliament to furnish State aid in the form of grants to Drainage Authorities and (through County Councils) groups of landowners for the carrying out of drainage work, and, to a less extent, water supply schemes for agricultural areas. The primary object for which State funds were supplied was the alleviation of unemployment, more particularly in rural districts. It must not, however, be assumed that the Ministry is blind to the other equally important results, which it has in a considerable measure been able to achieve, namely, the better protection of land against inundation and the improvement generally of the arterial drainage of the country.

This brief article deals with the schemes undertaken during the last season (1923-24) on which about £296,000[*] was spent in carrying out the various sea defence, drainage, and water supply undertakings, towards the cost of which the State is contributing approximately £190,000. A comparison of the expenditure for the two preceding seasons is, however, of interest, for in the season 1922-23 the gross total cost of works undertaken was £340,000 and the grants in aid, £250,000, whilst in the season 1921-22 the sum of £332,000 was expended, towards which the State contributed £235,000.

Wet weather—the retarding influence to the progress of all outdoor work—was the cause of the reduced expenditure last season compared with that of the preceding season, which in turn was, for the same reason, less than that of the 1921-22 season. In this respect, however, last season's schemes were particularly unfortunate, the average rainfall in England and Wales over the period affecting the work—September to May inclusive—being 31.15 in., whereas, during the corresponding periods of 1922-23 and 1921-22 the rainfall was 27.19 and 24.81 in. respectively.

Although 67 Schemes had to be abandoned and many were left uncompleted, a great deal of effective work has been accomplished, the 461[†] Schemes proceeded with having provided 710,712 man-days employment.

* This figure represents the anticipated total cost, which the accounts of all the Schemes will show after final examination.

† Extensions of time, of from 1 to 7 weeks, after 12th May, were granted in respect of 193 Schemes.

The Sea Defence Works carried out under 37 Schemes included the strengthening of embankments protecting lands adjoining the sea coast and tidal rivers up to the limit of ordinary high tides*; and the construction and repair of groynes on the foreshore for the protection of land against sea erosion.

The Drainage Works carried out under 353 Schemes included the cutting of new and the dredging of existing channels; the construction of and strengthening of embankments—other than tidal; the clearing of fallen and ingrowing trees and bushes, shoals, and cesses from rivers and brooks; the clearing of aquatic vegetation from, and the regrading of the beds of streams and dykes; and the building and repairing of bridges and sluices, etc.

The Water Supply Works carried out under 71 Schemes included the sinking of wells; the fixing of pumps and rams; the construction of new, and the cleansing and repairing of old reservoirs; the laying of water supply pipes; and the construction of drinking troughs.

Wages and Allowances.—The local rate of wages for unskilled agricultural workers as fixed by Conciliation Committees was paid on practically all the schemes, plus boot and tool allowances† at 2d. and 3d. or 4d. per day respectively to all workers who elected to equip themselves *suitably*. Train, 'bus, cycling or walking allowance was also granted to workers residing over 2 miles from their job.

Statistical Summary and Sketch Map.—The Statistical Summary and Sketch Map (p. 615) set out the schemes carried out in each of the seven Divisional Areas into which the country has been divided for the purpose of supervising the works. Space is not available to particularise many schemes, but it is hoped that the few photographs of works in progress and the sectional drawings of three of the channels dealt with, will have the effect of clarifying the short descriptions of the works mentioned.

The Nene Scheme.—The Nene (Smith's Leam), Guyhirne to Peterborough scheme illustrations (Figs. 3 to 6), together with the records of deterioration of this particular river, indicate the rapidity with which a neglected tidal channel can fill up, and the magnitude of the works necessary to put it in order

* In the case of the Rivers Ouse and Nene, this point is about 35 miles from the Sea

† These allowances are charged as "Materials" against Schemes where tools were not provided.

again. Forty years ago, three barges of ten-foot beam could easily be navigated past one another right up to Peterborough. In 1918, however, the river had contracted to 18 ft. for a stretch of about one-third of a mile—3 miles downstream of the highest point to which ordinary tides flow; in 1921 the width had narrowed to 14 ft., and before the scheme was started in 1923 to 6 ft. On the last-named section of the river the works included the demolishing of a bridge 29 ft. wide, and the construction of a new one increasing the waterway to 46 ft.

In addition to the Drag-line Dredger illustrated, a Floating Grab Dredger was used on the upper reaches of the river, the workers being employed consolidating the spoil and forming embankments behind the dredgers.

The Meathop Marsh Scheme.—The Meathop Marsh scheme was undertaken as a consequence of the river Kent having changed its course in the estuary above Arnside railway viaduct, thus rendering the old sluiced outfall of a very extensive catchment area inoperative. The new cut and embankment shown in the illustrations (Figs. 1 and 2) are each over a mile long and incidentally the latter reclaims 430 acres of marsh proposed to have been enclosed under a scheme examined by the Reclamation of Land Branch of the Ministry in 1919. The excavating of the new cut involved the blasting of rock over a distance of 160 yds., including a length of 30 yds. where the rock projected 8 ft. average above the general ground level, and the works included the construction of a range of 3 sluices in a concrete superstructure and a road bridge of steel.

The Cley, Wiveton and Salthouse Marshes Scheme.—This undertaking became necessary by reason of the Cley channel —the tidal outfall of the River Glaven—having become choked with shingle washed into it from the beach, 1½ miles from where it enters the Blakeney channel. The works, which involved the cutting of a ½ mile of new channel 30 ft. wide and 7½ ft. average depth, provided employment for 40-50 men between early January and the end of June.

The Burnt Fen Scheme.—The Burnt Fen illustrations (Figs. 7 to 9) have reference to the work carried out on one of two schemes undertaken by the Commissioners of that drainage area on one of their main drains preparatory to installing new pumping plant. The illustrations will indicate to those unfamiliar with the Fens the magnitude of some of the dykes, and the amount of work involved in their improvement

and maintenance. A larger main drain than that illustrated was widened and deepened under one of six schemes undertaken by the Soham or Middle Fen Commissioners, but no photographs of the works are available.

Minor Schemes.—As regards the smaller but by no means the less important works, a little criticism of the disinclination of contributors towards schemes in certain districts to improve the culverts concurrently with the widening and deepening of the drains, appears necessary. As a matter of fact there is a tendency towards diminishing the sizes of the culverts under field gateways when substituting more lasting fireclay or concrete pipes for decayed timber trunks. For instance, in a certain fen, trunks averaging 10 in. square, were replaced by field pipes of 5 in. diam. before the Inspector had arrived and could advise. In contrast to this, however, it may be pointed out that on certain marshes where it was intended to replace trunks averaging 7½ in. square by concrete pipes of 2 ft. diam., the size was increased to 3 ft. diam. on the suggestion of the Inspector. As the dimensions of the dykes in the fen and the marshes are comparable, a casual comparison will indicate what the natural sequences to the policy of *economy* in the fen and the progressive policy in the marshes will be!

Hand Tools Used.—A criticism of the use of too heavy and awkward tools appears even more necessary, and by way of tempering the censure, four photographs (Fig. 10) are introduced to record the evolution of the " Dydle " of to-day " D." Dydle " A " was in general use for clearing dykes when the Fens were unconsolidated peat; later, necessity evolved types like " B " and " C," when the " slub " in the dykes ceased to be buoyant and subsided. The bulk of the Fen lands have now become so consolidated by drainage, manuring and " claying," that, generally speaking, the dykes requiring cleansing are dammed off in sections, baled out and cleared of spoil with shovels operated by men in knee or thigh boots, according to the depth of the " slub "; nevertheless, dydles even heavier than " B " and " C " were brought along for use on unemployment schemes where " damming off and shovelling " were not in favour by reason of some of the dykes having the reputation of being " bottomless," or where streams could not be diverted to enable shoals and cesses to be removed.

Dydle "A" is a good tool for removing duckweed and semi-buoyant " slub " from dykes on undeveloped Fens, but as to " B " and " C " the less said the better! However, perusal of

the letterpress to each photograph should suffice to indicate to the promoters of future schemes that the design of tools should not be left to hefty "village blacksmiths," lest monstrosities such as "B" and "C" be perpetuated. Dydle "D" is a very good tool—much in favour in East Suffolk, where the cost of cleansing marsh dykes has been greatly reduced by its adoption—no damming boards, shovels, knee or thigh boots being needed. The head of this dydle is made of sheet steel riveted to a wrought neck into which is fitted an 11 ft. 6 in. smooth pine handle tapering from the head.

Tackle Used.—The tackle illustrated—"The Devil"—is of historical interest, having been in general use on the rivers of Norfolk and Suffolk down to 30 years ago. The huge waterlogged tree shown and about 150 others of various dimensions were removed from the river Stour with two sets of this tackle, by small squads of men—traction engines having failed to shift the tree shown in the photographs (Figs. 11 to 13). Incidentally for heavy loads the lever should be operated by a rope attached to a ring on the end of the long arm, and not as shown, to insure the safety of the workers if a link in one of the chains should break.

Apart from ordinary maintenance, a great deal of constructive work has yet to be undertaken on rivers, brooks and dykes in order to overtake the effects of the arrears which accrued during the War; for instance the staunching of the miles and miles of embankments which have become leaky on account of cessation of hostilities against *the mole*—as to which the Ministry recently issued a circular to all Drainage Authorities in England and Wales (*see* also p. 681).

Beneficial Results of Drainage Operations.—It is very desirable to add that, apart from the beneficial effects of efficient drainage on arable land and the quality of the herbage of pastures, there are direct benefits derived from the abatement of floodings and waterloggings of land about which little has been written. Having regard to the importance of these further benefits it is remarkable how seldom the Ministry's advice is sought in relation to land drainage problems arising in connection with the injury or total loss of livestock. As to the connection between the health of livestock and imperfect drainage farmers generally do not apparently realise to what extent livestock suffer from the attention of gnats, of which there are about 22 British species including Mosquitoes (*Anopheles* and *Culex*). It should be appreciated that female gnats and the

STATISTICAL SUMMARY AND DIVISIONAL AREAS.*

No. 1 Hunts, Cambs, Beds, Norfolk and Suffolk
,, 2 Wales and Shropshire, Worcester, Hereford and Monmouth
,, 3 Northumberland, Durham, Cumberland, Westmorland, Yorks, Lancs, Cheshire, Stafford and Warwick
,, 4 Derby, Notts, Lincs, Leicester, Rutland and Northants
,, 5 Essex, Kent and E. Sussex
,, 6 Gloucester, Wilts and Somerset
,, 7 Oxford, Berks, Bucks, Herts, Middlesex, Surrey, W. Sussex, Hants, Dorset, Devon and Cornwall

		Area Numbers	1	2	3	4	5	6	7	Totals
Carried out by	Drainage Boards	Dr'ge	41	17	19	25	12	24	8	146
		Sea D.	3	—	—	5	17	2	1	28
		Totals	44	17	19	30	29	26	9	174
	County Councils	Dr'ge	15	26	51	20	3	68	24	207
		Sea D.	3	—	—	—	5	—	1	9
		W. S'py.	—	1	4	—	3	55	8	71
		Totals	18	27	55	20	11	123	33	287
	Combined Totals		62	44	74	50	40	149	42	461
Schemes	Drainage		56	43	70	45	15	92	32	353
	Sea Defence		6	—	—	5	22	2	2	37
	Water Supply		—	1	4	—	3	55	8	71
	Totals		62	44	74	50	40	149	42	461
Benefit	Approximate Acreage		191,400	32.000	81,800	237.800	42,600	105,200	36,500	727,300
Labour	Number of Man-days Worked		143,073	51,983	127,390	75,623	82,862	146,160	83,621	710,712
Approximate Expenditure	Drainage £		49,027	20,970	59.536	22,814	11,427	39,165	20,890	223,829
	Sea Defence £		1.701	—	—	6.397	18,804	1,287	4,136	32,325
	Water Supply £		—	354	518	—	530	7,846	5,439	14,687†
	Totals £		50,728	21.324	60,054	29,211	30,761	48,298	30.465	270,841

* Divisional Areas follow the boundaries of the watersheds of Main Rivers and do not coincide with the County boundaries in a number of places.

† This figure represents the amount of the Grants only, the actual cost of the works being approximately £40.000.

females of all blood-sucking flies (*Tabanidæ*: Gad flies, Horse flies, Breeze flies) favour feeding on domestic animals rather than on human beings; that the summer onslaughts of these pests are made at night;* that they hibernate in stables, cattle sheds and piggeries—preferably the last—and feed on the animals housed therein during the winter; that the "breeding grounds" of gnats are stagnant waters interspersed with vegetation, and those of the tabanids are waterlogged soils. None of the gnats or biting flies is a *proved* disease carrier in Britain excepting *Anopheles* (*Maculipennis*)—a malaria carrier—but evidence is accumulating against tabanids as being the cause of the spread of Surra and other equine diseases in Asia and Africa.

Lest it appear that the suppression of mosquito breeding could be brought about by spraying the mature insects with an insecticide whilst hibernating, it should, however, be understood that mosquitoes also hibernate as larvæ—the "wrigglers" one sees in shallow ditches, and in hoof prints in swampy ground—so that the destruction of the adults will not suffice. The only lasting remedy is a periodical drying of the soil and clearance of the vegetation in the ditches, in order that the natural enemies of the mosquitoes may be unrestricted.

As regards the connection between the total loss of livestock and imperfect drainage, attention is called to the following article on "The Influence of Good Drainage in Relation to Certain Parasitic Diseases of Stock," by Capt. R. Daubney, M.Sc., M.R.C.V.S.

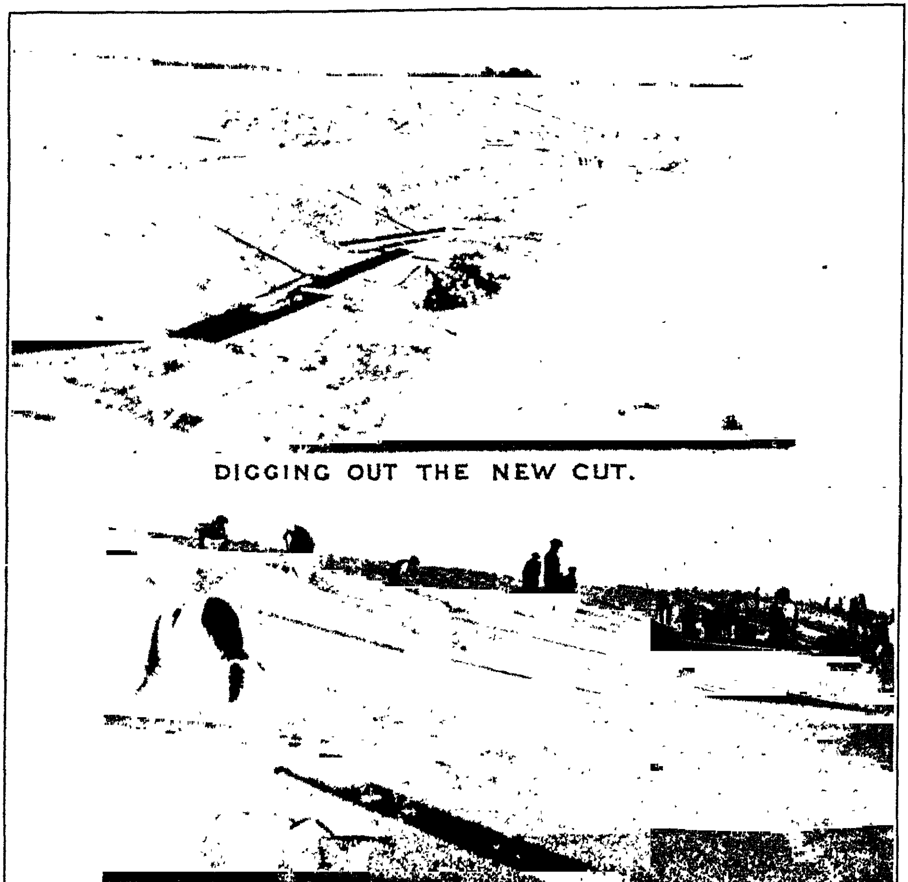
* * * * * *

THE INFLUENCE OF GOOD DRAINAGE IN RELATION TO CERTAIN PARASITIC DISEASES OF STOCK.

R. DAUBNEY, M.Sc., M.R.C.V.S.,
Helminthologist, Diseases of Animals Branch, Ministry of Agriculture.

AN important aspect of drainage operations to the farming community is the effect which good drainage exercises upon the incidence of certain animal parasites of stock, particularly parasitic worms. The magnitude of the annual loss from diseases directly caused by parasitic worms is perhaps only realised by those who, as specialists, are called upon to assist in the control of outbreaks of more than usual severity.

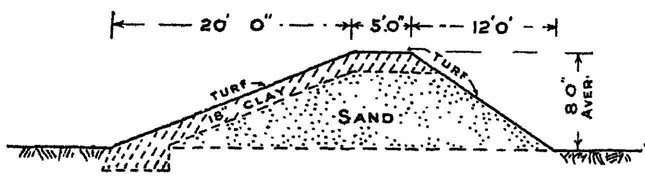
* The range of flight of mosquitoes is well established, being up to 1 mile from the breeding *grounds*.



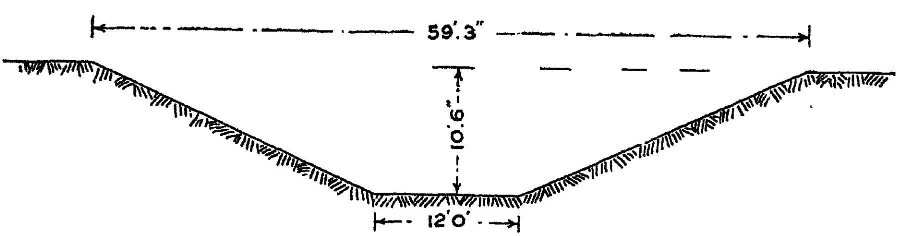
DIGGING OUT THE NEW CUT.

FORMING EMBANKMENT WITH SPOIL. FROM THE NEW CUT

Fig. 1.



SECTION OF NEW BANK.



SECTION OF OUTFALL CUT.

Fig. 2.

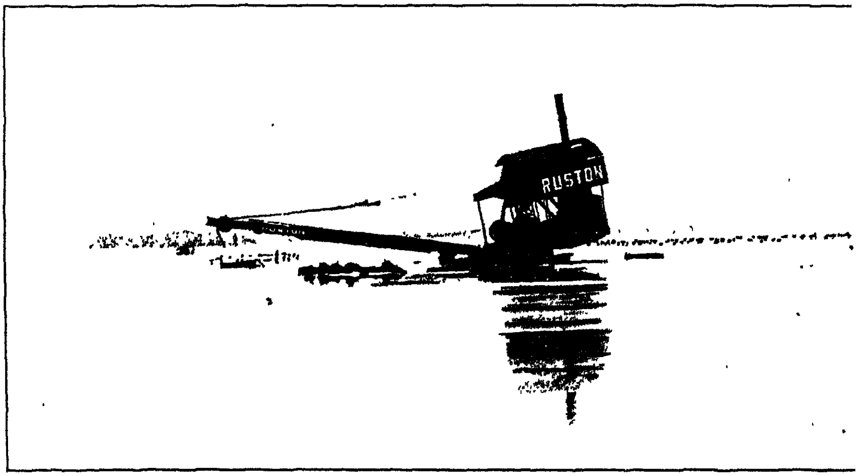


FIG. 3.—Drag-line Dredger en route to job across Wash lands—two miles to go.

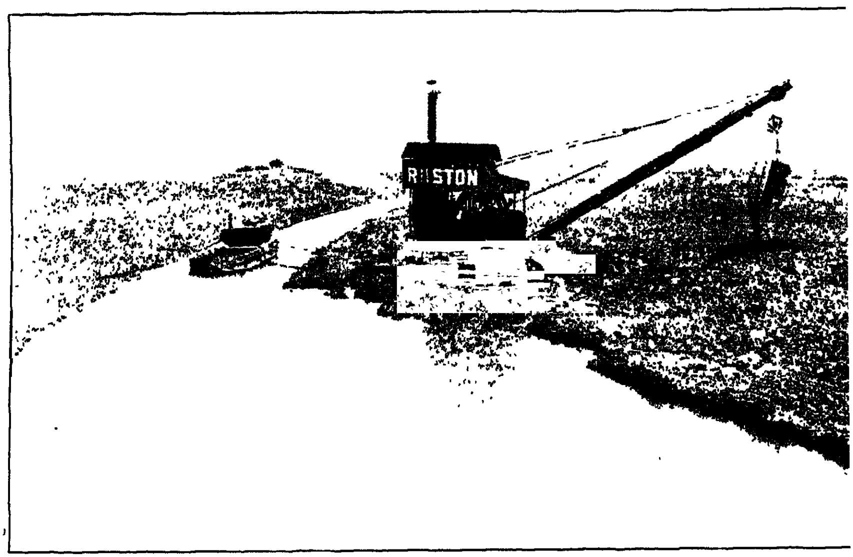


FIG. 4.—Completing job; cleared Reach of River, shown in the Sections (Fig. 6), may seen in the Distance.

THE NENE (SMITH'S LEAM) SCHEME (Area No. 1).

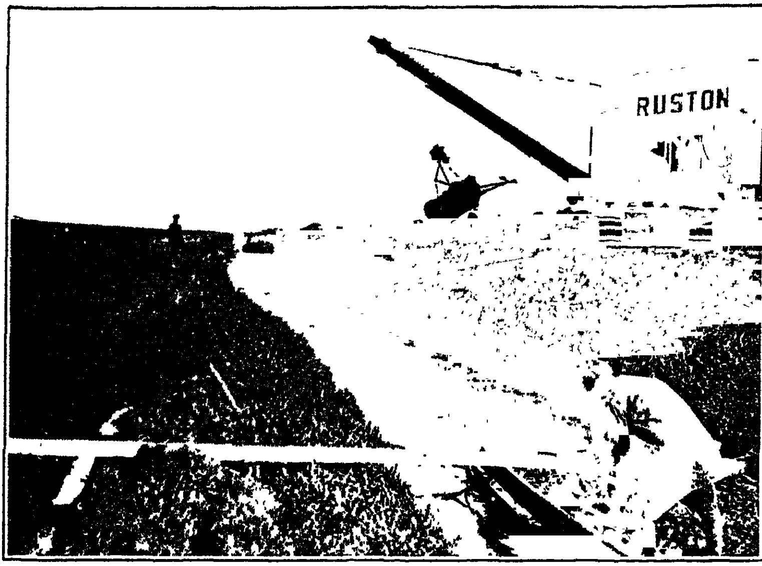


FIG. 5. -Drag-line Dredger at work.

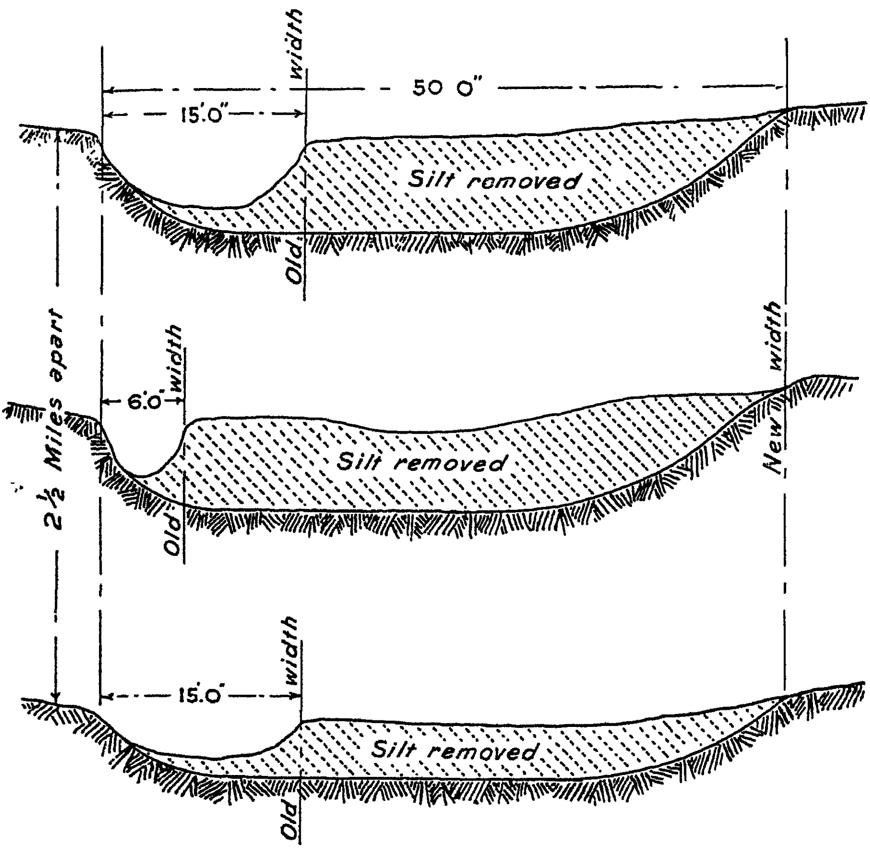


FIG. 6.—Sections looking Down Stream.

THE NENE (SMITH'S LEAM) SCHEME (Area No. 1).

FIG. 7.—Sinking and Widening the White House Drain—lower end.

FIG. 8.—The Dam ¼ mile distant from lower end.

BURNT FEN SCHEME (Area No. 1).

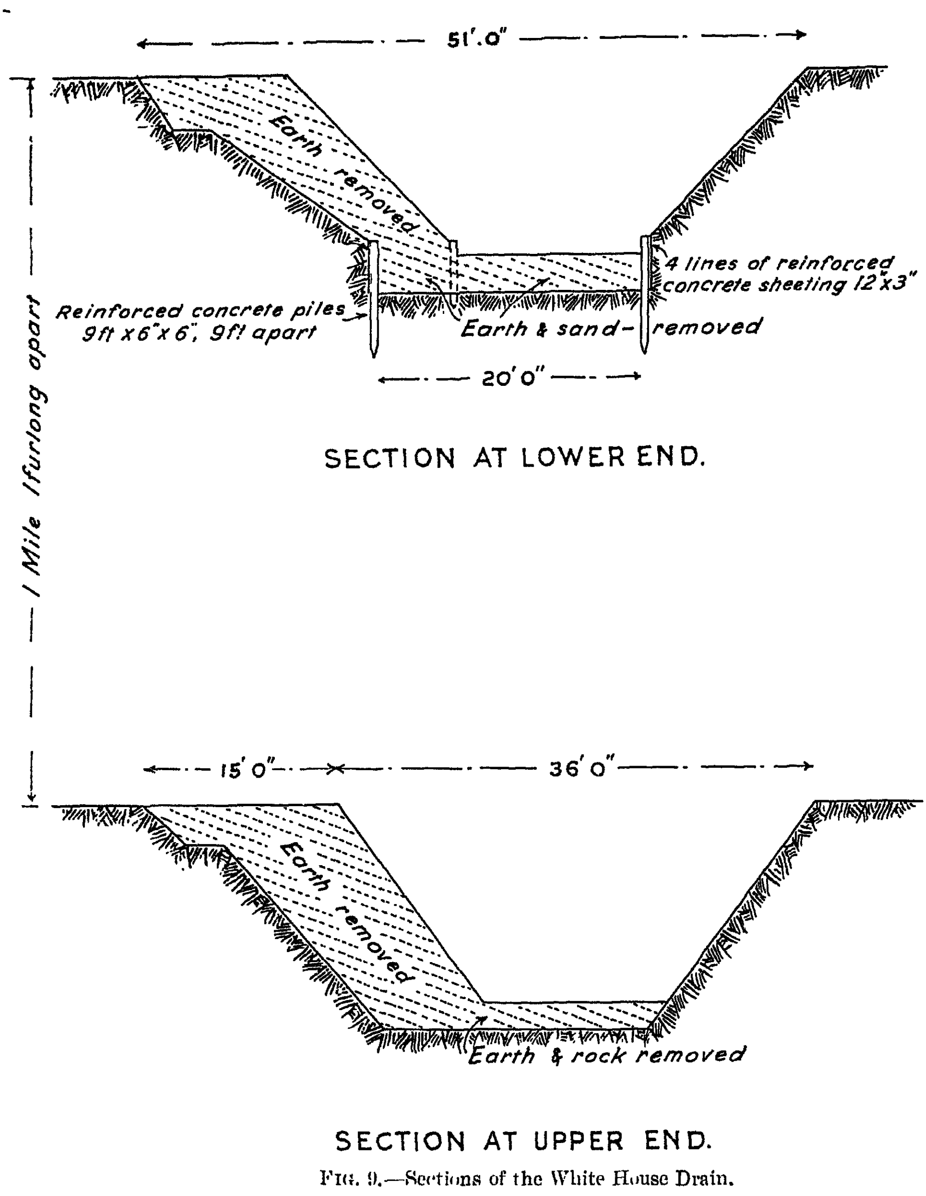
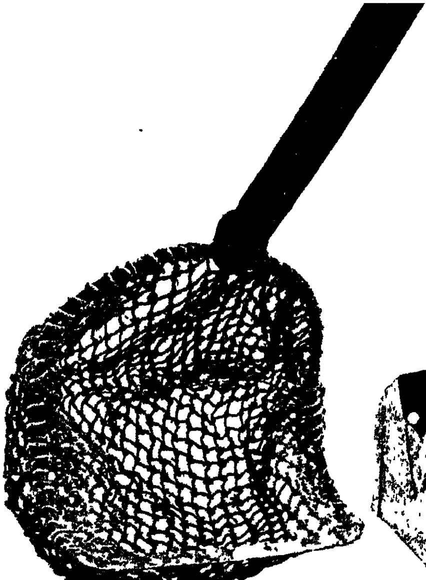


FIG. 9.—Sections of the White House Drain.

BURNT FEN SCHEME (Area No. 1).



(A) Net Pattern—5½ lb.—A good tool for removing duckweed and semi-buoyant "slub" from dykes—a trifle too heavily built.

(B) Box Pattern—7¾ lb.—A useless tool, much too heavy: mud has to be shaken out on landing.

(C) Scoop Pattern—10 lb.—Another obviously useless tool—even worse than (B).

(D) "Modern" Pattern—4½ lb.—A good tool for mudding Marsh dykes, found by workers very handy after a couple of days use.

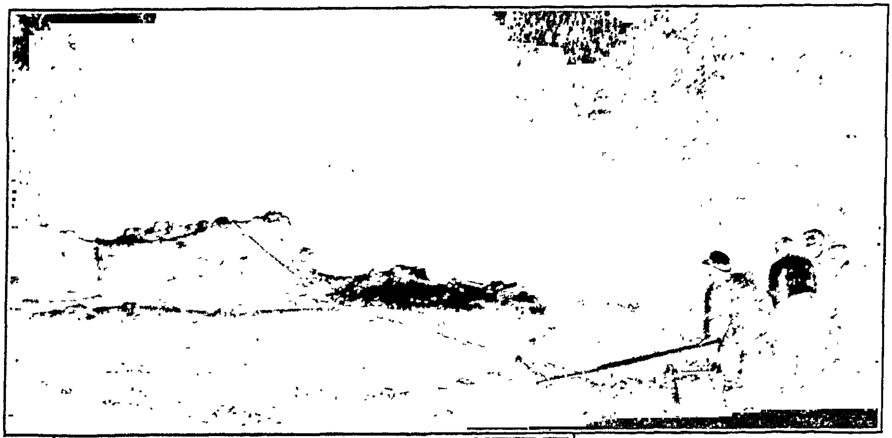


FIG. 11.—Lever in action, Anchor and Fulcral Chain.

FIG. 12.—Operation of hitching up one of the two Lever Chains on completion of a pull.

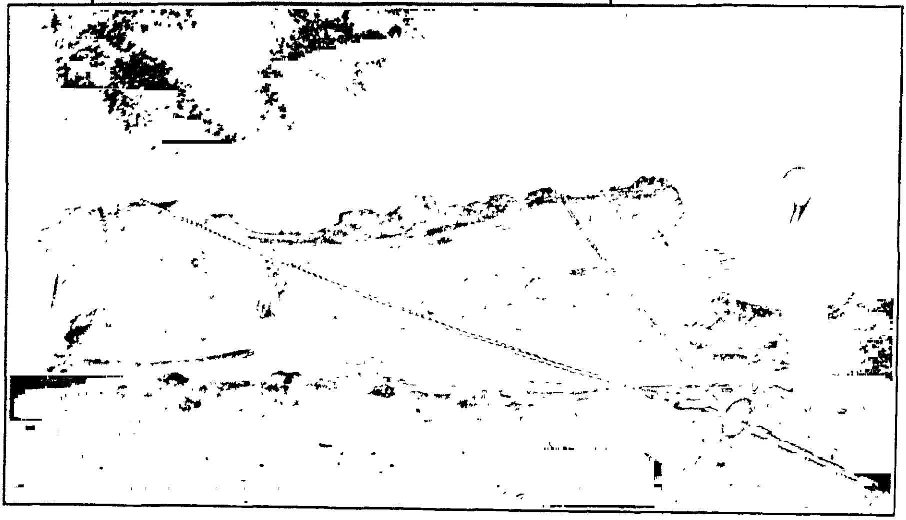


FIG. 13.—Grip Chain fixed to ensure rolling movement.

RIVER STOUR SCHEME: Tackle "The Devil" used for removing submerged Tree Trunks (Area No. 1).

The greatest losses occur amongst sheep, and are most frequently occasioned by small Nematode worms belonging to four strongyled genera (*Ostertagia,' Trichostrongylus, Haemonchus* and *Dictyocaulus*).

Life-History of Strongyles of Sheep.—These worms in the adult stage live in various parts of the digestive tract, with the exception of *Dictyocaulus*, which inhabits the bronchial tubes.

Life History.—The life-histories of these worms have certain essential features in common, which may be briefly summarised. The eggs or embryos deposited by the adult worms pass out with the droppings of the sheep on to the pasture. Here, in the case of the eggs, hatching takes place after some hours' development under favourable conditions. The newly hatched young worm or larva, after a further period of from 24 to 72 hours, undergoes certain structural changes which are accompanied by shedding of the cuticle or skin. That is to say, it undergoes a "moult." Some hours after this the larva undergoes a second moult, but in this case the cuticle, although everywhere completely detached from the body (which has developed a new covering underneath) is not, as a rule, shed, but is retained as an additional protective envelope. The young worm has now reached the limit of its free development, and before it can proceed any further towards the adult stage it must enter the body of a suitable host—in this case a sheep.

Although the young worms at this stage generally have a fairly high degree of resistance to drying, due in great part to the protective sheath, the earlier stages, both before and after hatching, are extremely sensitive to drought. A few moments drying will suffice to destroy the embryos in the eggs, or the larvæ before their second moult. It will be apparent that on well-drained land the sun is able to dry up and destroy these larvæ in great numbers during the earlier stages, while on badly-drained land that is waterlogged or occasionally inundated a vastly greater number of these larvæ survive to reach the more resistant infective stage. Where the last-mentioned conditions obtain, there results in an unusually rainy season an extremely heavy infestation of grazing animals with these parasites, with consequent heavy losses, more particularly in young stock, from the diseases they produce. In practice extensive losses from infestation with these parasites are almost entirely confined to areas which are in need of effective drainage.

Prevention.—It will be realised that in the case of animals at pasture it is impossible to control the disposal of the fæces

of infested animals, and so to prevent the dissemination of eggs on the pastures. The problem of prevention, however, can be solved by the destruction of the free-living stages of the worms on the pastures, and by treatment of infested animals. Treatment of individual animals is expensive and in certain cases ineffective. In any event, it does little to prevent recurrence of the losses unless it is accompanied by other measures. Of such other measures drainage is the only one of which the benefit is permanent. Good drainage ensures the destruction by desiccation of large numbers of the larvæ during normally dry weather, and reduces the chances of survival of the developing stages of the parasites to such a degree that animals pasturing on the land acquire only a light, or normal, infestation. which is tolerated and does not lead to any impairment in health.

Losses Prevalent on Undrained Areas.—It is of interest to remark here that several instances have come to the writer's knowledge in which, out of flocks of from three to five hundred, more than two hundred lambs have died during a season as a result of heavy invasion by *Ostertagia*. Similar losses occur amongst calves and deer as a result of infestation with species of *Trichostrongylus* and *Ostertagia*.

"Red-Worms" in Horses.—There are certain areas used for the grazing of horses on which farmers anticipate a normal loss of from 25 per cent. upwards among the young animals. In this case the so-called "red-worms" are responsible. These have a life-history essentially similar to that outlined above for the sheep-parasites, and their larvæ are equally sensitive to drying. When present in large numbers in the gut of young horses they cause persistent diarrhœa, anæmia, and death from debility. The losses in this case are by no means confined to young animals: adult animals also die. The writer has seen all the working horses of a farm so debilitated by the attacks of these parasites that the farmer was unable to complete his harvest with his own working animals. A mature working horse that is very heavily infested is quite incapable of performing an ordinary day's work. It has already been remarked that bad outbreaks of helminthiasis amongst lambs are almost entirely confined to areas which are badly drained, and it might be added that helminthiasis of horses is even more strictly confined to waterlogged land. When one hears it said that certain land is too wet for lambs or for horses or calves as the case may be, such a remark almost invariably means that experience has

taught that the pasturing of young animals on that particular piece of land is fraught with dire results in the shape of deaths from helminthiasis.

Liver Rot.—Another disease of sheep which is intimately associated with drainage conditions is Liver Rot. This disease is caused by the presence in the liver of large numbers of the Trematode or flat-worm, *Fasciola hepatica,* and in certain seasons the losses occasioned by this parasite assume the character of an epizootic. In the season of 1920-21 it was calculated that over 100,000 sheep died, or were sent to the butcher in a diseased state, as a result of the ravages of this parasite. In general its effects are very similar to those of *Ostertagia* related above. That is to say, in a normal season loss is very slight, but when weather conditions are favourable to the survival of the developing forms of the worms, extremely heavy infestation takes place with a very high mortality in the flock. As an instance may be cited a case that came to the writer's knowledge, in which one farmer lost over 400 ewes out of a flock of 420. These animals all died between November and the following January.

The life history of this parasite is interesting in that it requires an intermediate host, a small fresh-water snail, *Limnæa truncatula.* The eggs of the parasite are deposited in the bile-ducts of the liver and pass out with the fæces of the sheep on to the grass. There, in favourable conditions, among which the presence of moisture is essential, the eggs hatch, liberating a free-swimming embryo, which must immediately seek the intermediate host and bore into its tissues. This embryo lives only some 36 hours, and during this time it must find the suitable snail. Once in the tissues of the snail a process of division takes place, as a result of which eighty or more young worms called *cercariæ* eventually leave the body of the snail. The *cercariæ* after escaping from the body of the snail encyst on grass blades or other objects and remain quiescent, often for months, until ingested by a sheep or other suitable host, in the liver of which they develop into adult worms. The eggs of these worms recommence the cycle. A consideration of this life history will show that destruction of the snails on the pasture breaks the life cycle and so prevents future infestation.

The particular snail, *Limnæa truncatula,* is a small fresh-water snail which breeds in stagnant water and slow-running dykes. It is not found in clear, fast-running streams. It has a habit, however, of wandering in great numbers from the ditches over

marshy or inundated land. When floods have subsided breeding may be observed to be taking place in isolated patches of shallow water which have remained in the fields, and on such pastures the snails may be widespread. At such places as are trampled constantly by sheep or cattle, *e.g.*, the entrance to fields or drinking places, snails may be so numerous that it is impossible to put down one's foot without covering dozens at every step. It will be obvious that such conditions are ideal for the development of the fluke eggs that pass out with the fæces of the sheep. Indeed, it has been observed that fluke occurs regularly in certain areas after each inundation.

Various methods have been devised to destroy the snails. The use of dressings of lime or salt have been advocated for many years. The snail, however, possesses a considerable degree of adaptability to variations in salinity, and such dressings are of no value, as might be deduced from the frequent occurrence of severe outbreaks of Liver Rot on salt marshes. It was found by the writer, and subsequently confirmed by other observers that copper sulphate, which had already been used for the destruction of related snails, was extremely toxic to *Limnæa truncatula*. As a result of laboratory experiments, the plan was adopted of spraying infested pastures with a one per cent. solution of copper sulphate, and dressing ditches with powdered copper sulphate. Such treatment has been efficacious in removing snails from heavily infested land, and after two years one farmer reports the complete absence of fluke in the sheep killed for food. It was stated that in 40 years' experience on this particular farm never before had a whole season elapsed without the occurrence of some flukes in the sheep killed.

Although the effect of the copper sulphate treatment has apparently lasted for two and a half years, it is only a matter of time until conditions revert to what formerly was considered normal, and sooner or later spraying and dressing must again be undertaken. It will be recalled that it was stated that the snails in question live only in slow-running ditches and stagnant water. Such ditches should be improved wherever possible and periodically cleansed, the material that is thrown out on the banks being treated with powdered copper sulphate.

Efficient drainage of the land, however, including of course the prevention of inundations and the improvement of ditches, will confer permanent freedom, provided such drainage works are well maintained. As a proof of the permanent value of drainage works in this respect it is worth while to examine the

conditions to-day in two districts, which in the great outbreak of liver rot of 1879-81 were equally badly affected. One of these two areas remained quite free during the 1919-20 outbreak. The area that is now free from fluke is one that formerly was much more subject to inundation than the other, and in which extensive improvements have since been made. In the other area, although much of the land is waterlogged, the general conditions of farming are such that improvement has not appeared a matter of extreme urgency. As a result little has been done in this district in the way of general drainage. It was in this second area that practically all the losses occurred during the recent 1920-21 outbreak, while the better drained area remained quite free.

Preservation of Game Birds.—It might be remarked that drainage of land will also improve the quality of the shooting. Heavy losses among game birds occur during wet seasons as a result of infestation with species of *Trichostrongylus,* these parasites being the most frequent cause of the so-called "Grouse Disease." An instance may be cited in which the birds on a moor were almost totally destroyed by this disease. For many seasons the shoot was valueless. As a result, however, of the construction of a city reservoir draining this moor and the cutting of drains to carry off surface water, the condition of the birds on the moor gradually improved and their numbers again increased. The birds which have been shot during recent seasons proved to be in good condition and only lightly, one might say normally, infested. Such an improvement can only be attributed to the direct effect of the improved drainage.

It will be evident that in drainage we have the means to bring about a steady decrease in the annual wastage of stock from diseases due to parasitic worms. As the drainage conditions in areas improve so the losses from parasitic diseases will diminish. Already, where drainage has been undertaken, Liver Rot has disappeared entirely from areas which fifty years ago were amongst the most heavily infected.

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CONFERENCE OF AGRICULTURAL ORGANISERS HELD AT THE SCHOOL OF AGRICULTURE, CAMBRIDGE, JULY, 1924.

R. H. B. JESSE, B.Sc., N.D.A.,
Director of Agriculture, East Sussex.

IT has been contended that a great gap exists between research workers in agricultural science at the one extreme and the practical farmer at the other, and that results obtained by research workers are not readily assimilated into farming practice. There is little doubt that until comparatively recently this condition of affairs did exist, and that much valuable research work remained unapplied by the average farmer. To bridge this gap it has been advocated that research workers should endeavour to bring agriculturists into contact with the results of their work, and that knowledge of it should be disseminated in this way. Even assuming that all research workers would be willing to do so, it would be impossible for them to get into close contact with a very high proportion of the farming community. On the other hand it is probable that in England and Wales during the winter season no fewer than 100,000 farmers attend lectures and other courses which are given by Agricultural Organisers in their various counties.

It seems, therefore, that the Conference of Agricultural Organisers held at Cambridge in July, 1924, was a marked advance in the right direction, bringing not only the Organisers into touch with recent research work, but thus enabling them to disseminate it amongst the agricultural community. For this reason, apart from the excellence of the Conference itself, those who attended welcomed the facilities given them of being brought into close touch with a number of eminent research workers in agricultural science.

Feeding of Live Stock.—The opening paper of the Conference was read by Prof. T. B. Wood, F.R.S., on "The Basis of Rationing Live Stock." Prof. Wood in his paper outlined the progress of research work which had been carried out in this direction up to the present time. He discussed the methods employed by research workers and dealt with the various standards used by these workers in this and other countries.

It is probable that the most helpful part of Prof. Wood's paper to the Agricultural Organisers attending were the standards laid

down by him in connection with the requirements of fattening animals for beef. There is no doubt that in general farming practice there has been considerable waste of expensive feeding stuffs owing to a lack of exact knowledge of the requirements of animals and of the constituents of the foods used. Prof. Wood's paper clearly illustrated the requirements of different classes of animals in varying stages, the requirements of the average store animal, the half-fat and the fat animal. These standards were given both in terms of "calories" and "starch equivalents."

The progressive farmer at the present time has become quite familiar with the term "starch equivalent," and these standards now appear to be as practicable to enable farmers to fatten economically various classes of stock for beef as it has been found to ration dairy cattle for milk.

A point of considerable importance emphasised was the waste of protein which undoubtedly occurs on so many farms when animals are reaching the finishing stages. At present the price of protein in concentrated foods is exceptionally high, and if a system of rationing cattle based on these standards is employed, the saving in this direction alone would more than justify the efforts of those who arranged the Conference.

In his suggested scheme, Prof. Wood indicated that it is necessary to know the approximate live weight so as to ascertain the required maintenance ration, the age and condition of the animal in order to decide on the amount of starch equivalents for production, together with the foods available on the different farms and the markets for which the fatteners are preparing.

When discussing the question of baby beef, Prof. Wood pointed out that young animals did undoubtedly give a considerably greater live weight increase for food supplied them than did older animals, but on the other hand the prime 3-year-old fattened animal had spent a considerable part of its life existing on grass and other cheaply home-produced foods, and during that period it had been kept at a comparatively low average cost compared with that which would be necessary for the production of baby beef.

In the discussion following, it was suggested that to express the required standards for animals solely in terms of starch equivalents and not in calories might facilitate the working of such a scheme of rationing animals, and that maintenance rations for young animals based on the "surface law" would require very careful observation before becoming generally applicable to farming practice.

As a supplementary paper to that given by Prof. Wood, Dr. Crowther dealt with the many experiments he had carried out in connection with feeding pigs. Much of Dr. Crowther's work has become absorbed into ordinary farming practice, and generally seemed to be in accordance with the experience of most of the Organisers attending the Conference.

The rations suggested by Dr. Crowther, together with their high contents of fish meal, occasioned a most animated discussion, from which it was very apparent that uniformity of opinion concerning the effects of fish meal did not exist amongst those attending the Conference.

Mineral Needs of Live Stock.—Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, opened a discussion on "The Mineral Requirements of Animals." It was perhaps felt by those attending the Conference that Dr. Orr was dealing with a subject of great importance in connection with animal nutrition, in which there remained a large field for research before results could safely be applied to farming practice.

In his fascinating paper Dr. Orr stated that the mineral requirements of animals had, in the past, received too little attention, that scientists had confined their research work almost entirely to the non-mineral contents of food, and that its protein contents or the number of calories a feeding stuff could produce did not, by any means, sum up its value in connection with animal nutrition. He pointed out that the number of mineral elements in a feeding stuff exceeded the number of non-mineral elements, and that the mineral constituents of a food should not be regarded as merely the means whereby an animal built up the skeletal parts of its structure, but as constituents of its food vital for growth and reproduction.

He further emphasised the high mineral requirements of our improved domestic animals, and indicated that the heavy milking cow, giving from 5 to 10 gallons of milk daily, required a very considerable amount of mineral matter to supply this, while the rapidly fattening pig, increasing its weight by as much as 2 lb. per day, would also require much mineral matter.

He explained that the inorganic constituents of any physiologically balanced solution were present in the exact proportions required for supporting life. One of the most interesting illustrations given by the lecturer was that of experiments carried out on dogs. These animals, when fed on food from which the mineral constituents had been extracted, suffered severely from gastric and other troubles and died more quickly than did similar dogs that had been starved.

He dealt with the importance of the sufficiency of lime and phosphates in rations used, and stated that rickets was undoubtedly most prevalent when these constituents were deficient.

Dr. Orr indicated also that the adjustment of mineral assimilation was undoubtedly influenced by certain oils, for example, cod liver oil, and that sunlight was a factor which helped to rectify a deficiency of minerals. He further expressed the opinion that the beneficial results experienced in the spring months when cows were turned out to grass did not depend solely on the food constituents of the grass, but that sunlight in this case was a potent factor contributing to the beneficial results obtained.

It was further pointed out that an attempt to rectify deficiencies of minerals in rations at the present time by the addition of crude mixtures was a doubtful practice, as it would be extremely easy to adjust such rations incorrectly.

From the discussion following Dr. Orr's paper, and from the replies to the questions given by him, whilst the subject of mineral nutrition appears to be of the utmost importance, it seemed apparent that research workers are scarcely in a position to advise as yet how in farming practice the best results may be obtained by the application of their work, and that a badly balanced mixture might be worse than a deficient ration.

At the conclusion of Dr. Orr's address, Capt. Elliott, M.P., of the Rowett Research Institute, gave an outline of the research work in which he was engaged concerning the effect of the mineral contents of pastures on sheep. Capt. Elliott contended that too little attention in the past has been given to this important side of animal nutrition and that he regarded the products of the soil, such as grass and turnips, as the plant's analysis of the soil, and that with our present artificial pastoral system with domestic animals it was essential to provide minerals required by the animals and lack of which in the wild state was rectified by the animals themselves, *e.g.*, the migration of herds of buffaloes from one district to another in order to remedy the deficiency of minerals in any particular district.

From Capt. Elliott's remarks it seemed apparent that there is a close correlation between the mineral deficiency in poor pastures and the rate of mortality in such districts, and that certain specific diseases may become more apparent when definite mineral deficiencies exist. Capt. Elliott indicated the practicability of research workers differentiating between the grass of one district and that of another by an examination of the ash of the particular herbage in question.

Fertility and Sterility of Live Stock.—On 24th July a discussion was opened with an address by Dr. F. H. A. Marshall, F.R.S., on "Fertility and Sterility of Farm Animals." In his opening remarks Dr. Marshall discussed the physiology of reproduction, and explained how a number of factors, the outcome of domestication, frequently interfere with the reproductive cycle amongst domestic animals, and that the fertility of farm animals depended on a number of causes, some of which may be controlled by the animal breeder.

Possibly one of the most interesting parts of Dr. Marshall's paper dealt with the influence on the reproductive organs of an abnormally fat condition in animals. From the description of the lecturer and his diagrams, the physiology of this state and its importance in farming practice was made most clear to the audience. It was pointed out that the line of demarcation between physiology and pathology in this connection was not distinct, the one subject merging into the other.

Sterility of farm animals might, however, be due to a number of varying causes, such as malformation and malnutrition, or to the persistence of the corpus luteum, usually termed the "Yellow Body." Dr. Marshall stated that a number of stockmen were sufficiently expert to remove these bodies which might occasion sterility. He further dealt with other pathological causes of sterility, such as the existence of cysts in the ovary, etc.

Visit to the University Farm.—The Conference visited the University Farm at Gravel Hill in the afternoon of Wednesday, 23rd July, and were received by Mr. H. B. Amos, whose lucid explanations of the various experiments and demonstrations were much appreciated.

The crops of Yeoman wheat, including Yeoman II, were first inspected and indicated the high condition and fertility to which the land on which they were growing had been brought during recent years. A number of methods of planting wheat after potatoes had been demonstrated in one of the fields. With the exception, however, of one trial where the seed had been ploughed in, it seemed as if most of the other methods had given equally satisfactory results on this type of soil. It would have interested a number of those inspecting the plots to have seen the results of similar trials carried out on some of the heavy gault soils found on the University Farm.

The experiments being carried out to find a satisfactory method of tattooing black-eared sheep promise to provide results likely to be of much value to pedigree flock owners.

It would take an article far exceeding the length of the present one to describe the various points of interest at the farm. Amongst them were trials of different varieties of maize, the results of which should be of considerable interest to growers of maize for silage; the effect of cocksfoot as contrasted with rye grass as hosts for frit fly; the demonstration of the efficacy of different strengths of formalin on seed wheat infected with "smut," etc.

The geological formation of the farm afforded an interesting study, especially the contrast between the gravel soils and the heavy gault clay, much of the latter, it is understood, having been recently added to the farm.

During the tour of inspection, numerous strains of oats and other cereals with which Prof. Biffen and his staff are experimenting were examined.

Rations for Dairy Cattle.—On 25th July the discussion on "Rationing Dairy Cattle" was opened by Mr. G. H. Garrad, Agricultural Organiser for Kent, in the absence of Mr. J. Mackintosh of the National Dairy Research Institute, Reading. Mr. Garrad outlined the origin of the scheme for rationing dairy cattle which had originated at the South Eastern Agricultural College, Wye. under Mr. Mackintosh's guidance. He described the initial trials carried out by Mr. Mackintosh, and later by himself, in testing various figures suggested as maintenance and production rations by Continental and other workers. Both Mr. Mackintosh and himself had satisfied themselves as to the soundess and accuracy of these standards before attempting to apply them generally on dairy farms in Kent.

Mr. Garrad gave the maintenance ration for a 1,200 lb. dairy cow as being 0.72 lb. digestible protein and 7.2 lb. starch equivalent, and a production ration for 1 gallon of milk as 0.55 lb. digestible protein and 2.55 lb. starch equivalent. His paper was fully illustrated by numerous figures collected in Kent. The data supplied by him showed very conclusively the advantages of rationing cattle according to yield. His figures also emphasised the value of heavy milking herds as economic milk producers compared with low yielding herds.

He outlined the Kent system, which has now become general in a number of counties, by which the Recorder of the Milk Recording Society not only records the milk yield, but the rations fed to each cow. The forms used show the dairy farmer the cost per gallon for food fed for producing milk compared with the average cost of other herds in the county which are being

rationed, whilst the scheme is completed by a letter, where necessary, from the Agricultural Organiser suggesting, if desirable, alterations in the rations fed.

A number of observations had also been collected by Mr. Garrad as to the condition of the cattle when rationed on Mackintosh's standard. These did not perhaps appear to be as conclusive as most of the data used by him, possibly owing to a number of recorders having mentally adopted different standards of condition.

A most interesting and gratifying point in connection with the scheme outlined by the lecturer was that very little improvement in the cost of production was noticed after the scheme had been operating for some time. Apparently farmers had so benefited by the advice given that they had reduced their cost of production very nearly to the minimum possible cost.

The discussion was continued by Mr. Boutflour, Agricultural Organiser for Wiltshire. Mr. Boutflour gave particulars of some most interesting work he had been carrying out on a number of dairy farms. Although the work carried out in Wiltshire had not extended over as long a period as that in Kent, it was very evident that Mr. Boutflour's work was an original contribution of very considerable value to the practice of rationing dairy cattle. Mr. Boutflour contended that a number of the rations widely used and advocated throughout the country contained too high a proportion of dry matter, and that he was obtaining far better results by limiting the total amount of dry matter, especially in the case of very heavy milking cows. He further contended that a herd of cattle that had been properly rationed during the winter months should not increase its output when turned out to grass, and that, in order to obtain the best results, the concentrated food should be fed to heavy milkers before they had satisfied themselves with crude fodder, as otherwise the cattle satisfied their hunger with the coarse fodder and then filled themselves to repletion with concentrated food.

The value of roots for producing milk was, in the opinion of Mr. Boutflour, often over estimated, and cheaper milk could frequently be produced by the substitution of concentrated feeding stuffs and the elimination or reduction of roots.

A considerable amount of discussion followed the papers of Messrs. Garrad and Boutflour, as on this subject a number of the Agricultural Organisers present had had considerable experience.

Among other matters emphasised was the need for variety in the concentrated feedings stuffs used. This observation on actual

results seemed to corroborate the views expressed by Prof. Wood earlier in the Conference on the need for rations containing not only a sufficient amount of digestible protein, but protein of the right types. As might have been expected, the value of roots for milk production appeared to be a very controversial subject, as experiences seemed to differ widely in various counties. Closer investigation into the contents of different varieties of roots grown on different soils and under different conditions would appear, from the discussion arising, to be desirable before dogmatic conclusions can be laid down concerning the use of roots.

The discussion on rationing dairy cattle ended what was unanimously felt to have been one of the most helpful and valuable Conferences that could possibly have been arranged. Those attending the Conference were deeply indebted to Prof. Wood and the staff of the School of Agriculture at Cambridge, and to others who contributed papers, together with those Officials of the Ministry of Agriculture and Fisheries responsible for the Conference. Throughout Prof. Wood and his staff had spared no effort to make the technical side of the Conference a success, whilst further, the hospitality shown both at the School of Agriculture and on the University Farm was greatly appreciated.

Agricultural Organisers generally, although extremely anxious to keep abreast with progress made in research pertaining to agricultural science, must of necessity find the difficulty of so doing to increase in a direct ratio to the success or otherwise of their work in their various counties or districts, so that the value to them of the Conference can scarcely be over-estimated.

Cambridge itself as a centre contributed in no small degree to the success of the Conference, the facilities afforded by the lecture rooms and laboratories of the School of Agriculture, together with that indefinable atmosphere associated with the University, making it an ideal centre for such a Conference.

* * * * * *

A SUCCESSFULL SMALL-HOLDING IN WEST CORNWALL.

W. PAYNE.

WHEN West Cornwall is mentioned one's thoughts immediately turn in the direction of early market gardening and flowers, or perhaps we think of the Cornish Riviera, visitors, and the catering for them.

The holding (Fig. 1) which the writer will try to describe, however, is not situated in the early market gardening district;

neither is it, as yet, in the immediate vicinity of any of the various popular resorts that abound on the western coast. It is among the granite hills in the parish of Lelant, about 3½ miles south-east of St. Ives, 2½ miles from the rapidly expanding resort of Carbis Bay, and about the same distance from the celebrated West Cornwall Golf Links. It is fairly typical of scores of others, scattered among the hills of the westernmost peninsula. Its total area is 50 acres, of which about 18 acres are rough waste land. It has a southern aspect, ranges from 350 to 480 ft. above sea level, and is somewhat exposed to north-west and south winds, but it is well watered.

Soil.—The so-called tillage portion of the holding is somewhat expensive to cultivate, owing to the fact that there are scores of granite boulders on or immediately beneath the surface of the soil in every field. These are not loose rocks, but a portion of the underlying rock of the locality, projecting above the surface (Fig. 2).

As might be expected from the presence of these boulders, it is a light granite soil, gravelly, somewhat free to work, shallow (on the brow of the hill only 4 to 5 in. deep), and dries quickly in hot, dry periods, but the grassland quickly recovers after rain.

The following facts are abstracted from a sheet of notes made in connection with work done at the County Agricultural Classes. The samples of soil were taken from a field about half-way up the slope forming the holding:—

Mechanical Analysis		*Chemical Results*	
Stones	11.74	Percentage of Lime ...	No effervescence—no $CaCO_3$
Moisture ...	3.60	Sourness (acidity) ...	Litmus very quickly reddened (Sour)
Organic Matter	9.10	Organic Matter (Humus)	Very fair amount
Gravel	16.29	Nitrogen (nitrate) ...	A fair amount
Coarse Sand ...	21.00	Total Phosphoric acid	Below the average
Fine Sand ...	22.75	Citric-soluble phosphate	A mere trace.
Silt	10.45	Potash	Relatively high for Granite
Fine Silt and Clay	13.80	Available potash ...	Traces
Loss	3.01		
	100.00		

The soil seems wonderfully adapted for the growth of the bramble or blackberry. This frequently grows 20 feet in a single season, consequently as the fences are chiefly constructed in the old style of turf and small stones it is a big job annually to keep back these and certain other plants, such as furze and blackthorn, for which the locality is just as notorious.

Fig. 1.—View of Farm and Homestead.

Fig. 2.—Meadow, showing Granite Boulders.

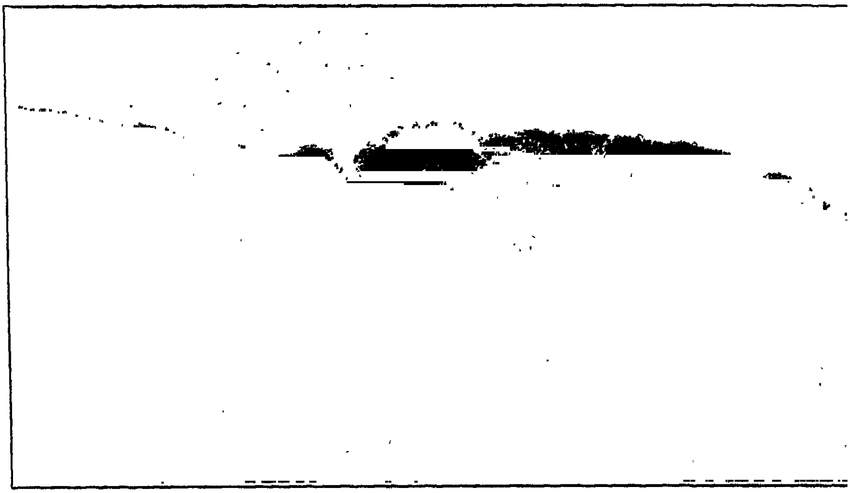

Fig. 3.—The two Horses.

Fig. 4.—Guernsey Bull reared on the Farm.

General.—Wild rabbits cause a good deal of trouble and expense, as they are very destructive and do a vast amount of damage. They seem to be on the increase.

Since the War, and in view of what has been said and written about arable dairy farming, an endeavour has been made to use as little as possible of purchased food stuffs. West Cornwall, as a whole, compares very favourably with other districts as regards the number of stock kept per acre, but stocking is often accomplished with the aid of large quantities of purchased foods, and the writer's idea in recent years has been to reduce that item to the minimum.

Having had several years' experience of the agriculture classes of the County Council the writer is of the opinion that the number of these should be largely increased. By their means information is brought directly to the farmer in the form in which he is best able to assimilate it, and a lesson or lecture, during the delivery of which the listeners are able to ask questions until every point is fully understood, is worth a whole field of reports from some college or department. The information gained and the training received not only make agriculture a more interesting profession but enable one to deal with the ordinary difficulties as they arise, without relying on the aid and advice of an official. The instruction received has led to the adoption of methods which are held to be erroneous by many farmers in the district, but which have produced satisfactory results.

In the first place, all farmyard manure produced during the late spring and summer months is stored until after corn harvest, when it is carted out and spread on the land that has been hayed. This secures a good " bite " of new, fresh grass until well on in the winter.

The next step is to manure some 8 or 10 acres of other grassland in early autumn, instead of waiting until spring, as is usually done: and although the past season 1923-4 was altogether unfavourable for this, being cold and wet, followed by a late spring, the results were very satisfactory.

Cropping.—With regard to the arable crops, the cultivated portion is kept as low as possible, owing to the expense of cultivation, the upkeep of implements, and the increased cost of harvesting. It is no joke to plough, sow or reap amongst the rocks, especially if one has a heavy crop. This year the corn crops were badly laid and harvesting consequently involved a great deal of extra work.

The usual cropping is 4-4½ acres oats, ½ acre mangolds, ¾ acre swedes, ¼ acre late cabbage, and ½ acre sundries (special crops).

I pin my faith to good cultivation, maximum crops, and personal attention to all matters in detail. Sufficient attention is not commonly paid to producing a good seed bed, and hence land gets foul and costs a lot to clean. From the time the ley is broken until it is re-seeded in the third year all land should be well cultivated and kept clean.

Also I differ from my neighbours in doing my deepest ploughing when breaking the ley, and gradually plough a little shallower in the second and third years. My reason for this is that by bringing up new and maybe cold and dormant soil the first year, the decay of the pasture herbage turned down, together with the action of the elements and the hoeing given to the root crops, and the cultivation of the second and third years' corn crop, and then liming before seeding out, the new soil is brought into available condition and the "seeds" thrive well in it; on the other hand when the ploughing is done the deepest for the third and last crop the seeds look weak and are often a failure.

Roots and Cabbage.—The root crops are always taken after the ley. This is ploughed over in December and January; about 15 lodas of farmyard manure are turned in for the ½ acre of mangolds, and 5 loads for the ¼ acre of cabbage, but no farmyard manure is ploughed in for the swedes, as, when that is done, the swedes grow rank and woody, and do not keep well.

We rely on 10 cwt. of lime with 4 cwt. superphosphate and 2 cwt. kainit per acre to produce the swedes. The cabbages get the same artificial mixture as the swedes in addition to the farmyard manure. For the mangolds in addition to the farmyard manure we give 2 cwt. nitrate of soda, 3 cwt. superphosphate and 3 cwt. kainit for the ½ acre.

It is not an ideal soil for mangolds, but a fair crop is generally secured, an average being 45 loads for the ½ acre (a load reckoned to be 12 cwt.). Yellow Intermediate is usually grown. The variety of cabbage grown is Late Purple Flatpoll, which grows to a good size, is of good quality and keeps wonderfully well. The ¼ acre averages from 12 to 15 loads. After extensive trials of various kinds of swedes, we rely on a local variety—King Edward—with Toogood's Hardy Favourite. They average from 45 to 50 loads for the ¾ acre. The mangolds are clamped in November, but the cabbages and swedes are taken from the field as and when required.

Oats.—The oat crop is generally in two small fields, (1) being after the root crop, and (2) 3rd year out and sown with "seeds"; the Black Tartarian after the root crop and white oats the following year. An average crop of oats yields 24 cwt. of grain and 30 cwt. of straw per acre; but ours is not thrashed. Oats after roots get 3 cwt. of 33 per cent. superphosphate and 1 cwt. of kainit per acre, and if it is a very poor field ½ cwt. of sulphate of ammonia is added for the swede portion. The oats to be seeded out get a light dressing of farmyard manure ploughed in early, followed later by 10 cwt. of lime and then 3 cwt. of 33 per cent. superphosphate and 2 cwt. of kainit per acre at seeding time.

The reason for sowing oats for the corn crop instead of dredge corn (barley and oats)—which is the general corn crop in this district—is that if the dredge corn is fed to the cattle in the sheaf, without first being thrashed, the bulk of the barley grain will pass through the animals undigested, and that means much waste of food. Further, the barley straw is not to be compared with oat straw for feeding purposes.

The oats are usually cut a little on the green side, at any rate earlier than if they were intended to be thrashed.

Other Crops.—Under the heading of "special crops" the chief item at present is growing cabbage plants for sale. By carefully growing and selecting for over 20 years, an excellent stock of Late Purple cabbage has been produced, and these command a ready sale in the district. They are, however, a gambling kind of crop, some seasons being very slack and dull, but the present one has been the reverse of this. Some seasons there are potatoes, peas, beans, etc., for sale, but this year we have only sufficient for home use.

On an average 2 acres of seeds hay and 2 acres of other grass are cut, which yield a rick of 11 to 12 tons; and this year we have from 7 to 8 tons left over from last winter in addition. The seeds mixture sown consists of:—

1 gal. Italian ryegrass,
7 gal. Perennial ryegrass,
1 lb. Timothy,
3 lb. Red clover,
3 lb. Cornish marl (perennial red) clover,
1½ lb. White clover,
1½ lb. Alsike,
1 lb. Yellow trefoil.

Other mixtures have been tried, but cocksfoot has never been sown as its results have been observed "over the hedge," and the mixture quoted does as well as any ever tried. Provided good quality seeds are sown it is the opinion of the writer that the success of the pasture depends more on the after treatment it receives than on the particular mixture sown.

The winter season therefore starts with, roughly, 4 acres of hay, 4-4½ acres of oats and 2 acres of roots, etc. This winter we have the hay left over in addition, but not such a good harvest as usual, nearly all the oats having been badly laid.

Stock.—A large rick of bracken is cut every year for litter, and all the ricks are thatched with rushes which grow in a moor near by. With the amount of food specified (as it is all reckoned as available for food) the average number of stock wintered is as follows:—2 small horses, 14 cows, one bull, 4 heifers, 4 yearlings. During the winter period we also commence rearing calves, and, on the other hand, we might sell a cow and calf, but the numbers mentioned form the standard. Last winter and during the present summer two or three more head of cattle could easily have been maintained.

All the stock are housed by night during the winter, but are out by day, excepting the bull and calves, which are in all the time until well on towards the end of May. A new cow-shed has just been built to provide accommodation for increased stock, and the buildings are now more compact and convenient.

Dairying.—The chief aim is dairy produce, and as we are not selling milk, but cream and butter, we are keeping cows of the Guernsey breed, and although they are not registered pedigree stock a pedigree Guernsey bull is used (the present one is out of an advanced registered cow), and the history of every cow can be traced back to the time of my grandfather without a trace of a beef breed coming in.

The heifers usually calve in late April or early May. At the time of writing the cows were due to calve as follows:—one in August, two in September, two in November, one in December, one in January, two in February, three in March and two in April. Probably one of the September, one of the November and one of the March calvers respectively will be sold and their places taken by heifers calving in May. Of the present 14 cows three are first calvers, two are second calvers and the rest of various ages.

Apart from low milk records, circumstances frequently arise which compel one to weed out cows from the herd, and the keeping of the herd up to anything like a standard is no light task. We have yet to prove that purchased stock are, or will do, better than stock raised on the farm, provided good judgment is exercised and great care taken in selecting it.

Before attempting to describe the indoor system followed it should be stated that during the summer months of an

average season an abundance of keep can be relied on, because the grassland is always manured with either dung or artificials.

Management of Grassland.—For the past two seasons, with the exception of the horses, bull and calves, which were in until the middle of May, the stock were all out of doors on 20th April and did not need anything in addition to grass until well on in November. As stated above, the land that has been cut for hay is dressed with about 12 loads per acre of farmyard manure, then, during the winter, as much as possible of the grass is dressed with farmyard manure—which, however, should not be applied after February because the cattle do not relish it, and consequently one gets a rank growth which ruins the quality of the pasture for succeeding seasons.

The rest of the grassland is manured with a mixture of 3 cwt. of 33 per cent. superphosphate, 2 cwt. of kainit and 5 to 10 cwt. of shell-sand (sea-sand) per acre. Shell-sand contains lime in a slow-acting form ($CaCO_3$), but being granular, is especially adapted for sowing on the surface of thick pastures, as it finds its way through better than other forms of lime—which tend to become pasty, and then dry and cake on the surface of the soil. The lump lime is to be preferred for sowing on ploughed land for swedes and when seeding-out. Shell-sand when mixed with the superphosphate and kainit forms a nice dry mixture for sowing; it dries up all sloppiness of the kainit and neutralises the acidity of the superphosphate, if any, and always gives wonderful results on our granite soils.

There is an old controversy in West Cornwall concerning the use of shell-sand—the older men contending that oats will always fail after its use. After using it for a dozen years, the writer's experience has been that if applied with judgment and common sense, it is no more harmful than other forms of lime. It is well known that on these soils, oats often fail after a dressing of burnt lime, and the same thing will happen if an excess of shell-sand is given. The cost of bringing the shell-sand to the farm by motor lorry is 6s. per ton, and as it contains about 6½ to 7 cwt. of lime to the ton it is the cheapest form of lime available here.*

Up to recent years the artificial manures for grass were put on in February and March, but now a fair proportion is sown in the autumn. The practice followed on this farm differs from that usual in the district in that, instead of dressing the

* An article on Sea-sand, by W. Borlase and Alex. Gregg, was published in this *Journal*, Oct., 1922, p. 591.

seeds with farmyard manure in early autumn, as on most farms, a mixture of (*a*) 3 cwt. superphosphate, 2 cwt. kainit, and some sea-sand, or (*b*) 4 cwt. basic slag, 2 cwt. kainit, and sea-sand, is applied, the aftermath being dressed with farmyard manure for the second year as mentioned before. By so doing, thicker and stronger seeds are produced, and a heavy crop of hay with an abundant aftermath is certain. There is more grazing in the second season, and the pasture forms a solid, thick turf much more quickly.

The object sought is to provide plenty of new grass in the autumn and early winter, and thereby maintain the condition and produce of the heifers which calved the previous May, and also to provide keep of good quality for the early autumn cows. I have never found any food purchased in a bag better than new grass grown on the farm, no matter what the period of the year may be. I know I am on dangerous ground here, and that I lay myself open to criticism, but having learned at the classes the requirements of the cow for itself and the growing fœtus, and for the amount of milk produced each day, and having also read and followed all the usual analyses of foods, including grass at various seasons of the year, I have always found that should a period of very cold weather set in and the bit of fresh green grass be cut off, no "bag" food seems able to take its place, although the cows are carefully attended, and are not allowed to stand about out of doors in bad weather.

Some may doubt the wisdom of sowing artificials in autumn, but one field of 2¼ acres that was manured as described last October (1923) did wonderfully well during the winter, kept 14 cows from 20th April to 8th May, was then shut up and cut to hay, which yielded excellently and is now (August) going strong and looking extremely fit for another season. Considering that the manure mixture costs roughly £1 per acre, this is a good result.

By the time the aftermath grass, etc., is getting spent the 2 acres of seeds will be well forward, then the portions which had farmyard manure and artificials respectively follow on in rotation. It is not suggested that the stock can fill themselves at that time of the year, but the bit of new grass produced and the more fibrous grasses in other fields keep them going and in good condition.

As an illustration it may be stated that our cows never yield as much on the new spring grass of early May as they do in

the month of June. My opinion of this is that the early grass is too rich in albuminoids.

Management and Feeding of Live Stock.—The calves are the first to be taken in at night, generally soon after Michaelmas, then in November the cows that are in full milk, then the horses; the rest of the cattle often remain out until December, but it all depends upon the nature of the season.

The horses (Fig. 3) get mangolds, hay, and sheaves of oats, varying in quantity according to the kind and amount of work that they are performing. As a rule the cows do not consume much dry food before Christmas, a good Flatpoll cabbage, with a little clover hay and a sheaf of oats being generally sufficient with what they gather outside during the day. After Christmas they get as much as they can clear up, with roots in sufficient quantity to keep the fæces on the thin side.

The daily routine with the cows is somewhat as follows:—at 4 p.m. they are brought in and given a little clover hay, any deep milkers receiving in addition some crushed oats. They are then milked, after which they get their roots, and at 8 p.m. are finished off with a sheaf of oats. If the sheaves are of good grain, they are "rushed," that is they get half a dozen blows over something fixed for the purpose and the grain falls on the floor, from which it is gathered, cleaned and then crushed. Individual feeding is followed; some cows do better on hay and roots, whilst others do best on a larger variety of foods.

The dry cows and those being dried off get a little hay, but chiefly get the sheaves that have been "rushed," with some roots. Should the feeding adopted seem rather inadequate it must not be forgotten that they always have a good bite out of doors, as, in addition to the fields, the waste portion (18 acres) grows a lot of fodder which the cattle eat readily during the winter and early spring period. They will not eat plain straw while they can get this kind of fodder. In the morning the same routine is followed and the cows are turned out to grass at about 9.30 a.m.

The yearlings are kept going with sheaves of oats and swedes. Feeding the yearlings well is very important, especially when dealing with Guernseys.

The calves are kept on the cows until they are a week old, those not required for rearing being sent to market, or, if fit, sold for stock purposes. When taken in to rear they get new and separated milk in equal quantities for 10 days, then they are gradually weaned off to separated milk alone and continue

with that for about three months. They also have a little clover hay and a sheaf of oats to pick from, and then get on to a few sliced roots; that is about all the treatment they get, and there is rarely any trouble with them.

We have no difficulty in selling our calves when necessary. Fig. 4 shows a stock bull that was reared and fed as described above, and which received nothing throughout but what was produced on the farm, neither had he any extra new milk. He was 2 years 2 months old when the photo was taken, and then weighed 12½ cwt.

Very little is done in the way of fattening cattle, but the bull is fattened off when finished with for stock purposes, and if a cow or heifer "goes wrong" and is not fit for dairy purposes, she is fattened. This, if possible, is accomplished on late summer or early autumn grass. Calves, however, are not reared with that end in view, the usual number reared being four heifers and a bull—the latter purchased from some well-known dairy herd. If the bull throws good heifer calves he is retained and then an additional heifer calf is reared.

Pigs.—With regard to pigs these are not now as prominent on this farm as they were two years ago, when two sows of the Large Black breed were kept and all their offspring were fattened off. At present only one sow is kept, and she is mated with a boar of the Long White lop-eared breed; the young pigs are generally of a greyish-blue colour. They run with the sow until 6 or 7 weeks' old, when they are weaned. They learn to take a little food, generally separated milk with a little sharps, from three weeks old. They run out until about four months' old, when they are put in the sty and finished off. Their food is chiefly made up of plenty of separated milk with sharps, thirds, and barley meal, or some such mixture. They are excellent doers, generally weighing from 160 to 170 lb. at six months' old, and the factory's extra allowance for type is often secured.

The sows are very prolific, generally farrowing in the 'teens of youngsters; the sow we now have has averaged 11 reared for her four litters. She usually farrows in October and April. Some of the autumn litter last year were sold, as the separated milk was required during the autumn and winter for the calves. Others were purchased during the summer.

Poultry.—Some poultry are kept, but during the last two years we have been unfortunate with them on account of raids by foxes. As on most Cornish holdings, the poultry are con-

sidered to belong to the women, and mere men folk are forbidden to have much to say about them. However, usually 40 hens are kept, generally White Leghorns and Rhode Island Reds, and they lay very well during the winter as there is always plenty for them to pick up.

Labour.—A good deal has been said about the laying down of land to grass and the consequent reduction of labour employed on the land. I do not think I shall be considered guilty over that item. I work full time winter and summer with plenty of overtime, as also does my wife, who looks after the poultry, helps to milk, makes butter, etc. Then I have a full-time man at 33s. per week, and, on an average, spend £15 per annum in casual labour. We are kept busy all the year round, our easiest months as a rule being October and November.

Purchases.—The total amount of manures purchased for the past year was :—

1 ton 30 per cent. Basic Slag.	2 cwt. Sulphate of Ammonia.
2½ tons 33 per cent. Superphosphate.	30 cwt. Lime.
2½ tons 20 per cent. Kainit.	8 tons Shell sand.
2 cwt. Nitrate of Soda.	

The total amount of food for all kinds of live stock purchased from 1st October to 20th May was 56 cwt.

It may be argued that in theory my system of feeding is wrong, and that if some highly-concentrated foods were used along with the home-grown foods, more stock still might be kept and better results obtained. Now with a season like 1924 with its abundance of keep that would work out all right, but we often get dry summers. The three preceding summers have had very dry periods, and then if keep fails one has to resort to purchased food during the summer, and although the rain may come and the grass grow again, my experience of the feeding of cows is that one cannot commence to give them concentrated food and then drop it off without feeling the effect, and the consequence is one has to keep it up. I have three neighbours here who are and have been working on those lines, and that is their experience. Again, my grassland is now of better quality than the average around here, as with such heavy purchases and feeding of rich foods neighbouring pastures are getting coarser every year through excess of nitrogen.

Sales.—During the period 1st October to 20th May, referred to above, 70 score of pork was produced and sold, and on the latter date the sow had with her eleven young pigs, five weeks old.

Our 14 cows average 245 lb. of butter fat for the year. It is expressed in that form because only one-third is made into butter at home, the other portion being sold to the creamery as separated cream. This is fetched by motor and paid for on butter fat content.

If, as is more usual among my neighbours, there were fewer autumn and winter calving cows and more of late spring calvers, the average produce of the cows could easily be raised; but the returns would probably be about the same, as with the present system a higher price for the produce is secured and the calves are got out of the way in order to have plenty of pigs during the summer. On an average a dozen pigs are fattened and sold during the summer.

There are five adult cows to sell each year. If everything goes well they are sold with calves by their side, otherwise they are fed, or sold for what they are worth. At present there is a great demand for in-calf heifers and cows, and good prices are being offered for them.

As regards future developments there seem to be two courses open—(1) to get into a registered Guernsey herd with milk records of the cows, as there is a great demand for such, as well as for bull calves out of cows with good records; or (2) to work up a retail trade in milk, cream and butter, to meet the summer demand now arising.

The drawback to the latter course is that the demand is not constant, as the visiting season only lasts from eight to ten weeks in July and August. There are also several growers of flowers in the neighbourhood who have come over from the Isles of Scilly, and the soil seems well adapted for the growth of flowers.

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SILAGE CROPS.

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THE rapidly extending practice of ensilage renders it very desirable that efforts should be made to discover the most suitable crops to grow for the purpose, in various parts of the British Isles. The climatic conditions in different districts of Great Britain and Ireland vary considerably, and a silage mixture which is found suitable in the dry districts of Eastern England may be quite unsuitable for the cooler and moister districts of the west, or of Ireland.

In East Anglia, where ensilage is perhaps more practised than in other parts of England, the most common crop grown for the purpose is a mixture of winter oats and tares.

In the autumn of 1920 a scheme of experimental plots was arranged jointly by Principal R. M. Wilson (then of Chelmsford, now of Wye) and the writer, by which the same silage mixtures were sown on four farms in Essex and Suffolk, in order to gain some information as to the suitability of these mixtures.

Essex and Suffolk Trials.—*In Suffolk* in 1920 all the centres were on heavy land. About an acre of each of eight mixtures was grown in one large field, and a small portion of the crop at two centres was weighed. At the third centre the crop was judged by observation.

The following are the mixtures used per acre, with the weight obtained at one centre (Mr. C. C. Smith) and certain observations upon the crop:—

(1) 2 bushels ordinary winter oats, 1 bushel tares. Crop 15 tons. Stood up well, and appears generally to do so. The objection to it is that it contains a smaller proportion of leguminous plants, and results in a silage containing rather less albuminoids, and of course does not enrich the land so much in nitrogen as would a mixture with a high proportion of leguminous plants.

(2) 2 bushels tares, ½ bushel rye. Produced 15 tons. The rye did not succeed at any centre, possibly owing to the heaviness of the land.

(3) 2 bushels tares, 1 bushel Marvellous winter oats. Crop 15 tons. Stood up fairly well. This variety of oats is very stiff in the straw. They are, however, somewhat deficient in tillering power and are not so winter-hardy as ordinary winter oats. In a cold winter they may suffer, especially on wet land. On kindly soil and in sheltered positions they are probably quite safe to grow in silage mixtures.

(4) 2 bushels tares, 1 bushel ordinary winter oats. Crop 14½ tons. Crop down.

(5) 2 bushels tares, 1 bushel Bountiful winter oats. Crop 14½ tons. Crop down. The Bountiful oats did not succeed so well as the ordinary winter oats.

(6) 2 bushels tares, 1 bushel winter beans. At one centre the beans were eaten by vermin. At the other centres this mixture stood up well and appeared promising.

(7) 2 bushels tares, 1 bushel wheat. The wheat got smothered by the tares.

(8) 1 bushel winter oats, 1 bushel tares, ½ bushel beans. This mixture was grown in another field and appeared very promising.

The summer of 1921 was very dry, in spite of which most of the mixtures did not stand up very well. This is a considerable disadvantage, as badly laid crops are difficult to cut, and in addition the lower portion of the stem becomes rotten. This

rotten material, if incorporated in the silage seriously depreciates its quality.

In *Essex* identical mixtures were tried in 1920 upon a light loam, and the writer is indebted to Mr. R. M. Wilson and Mr. McCreath for particulars of the results. The best individual mixture at this centre, both from the point of view of tons per acre and food units per acre was that consisting of 2 bushels of tares and ½ bushel of rye. The rye held the tares up better than the other cereals, and consequently a longer growth of tares was obtained. The inclusion of 1 bushel of rye in the mixture seemed to be too heavy a seeding of rye and resulted in a choking out of some of the tares.

In Suffolk, a further series of plots was put down in the autumn of 1921, and the following year a mixture of 1 bushel tares, 1 bushel of oats and 1 bushel of beans gave the heaviest crop and appeared on the whole to be most satisfactory. For heavy land this mixture appears to be very suitable, and it is now being used by an increasing number of farmers in Suffolk. Opinions differ, however, as to the value of silage made from beans. On light land the inclusion of rye in the mixture appears to be an advantage. Rye undoubtedly holds the crop up better than any other cereal—probably 2 bushels of tares and ½ bushel of rye is a suitable mixture for light land.

Mr. Wm. Makens, of Colney, Norwich, who makes silage on the trench or clamp system,* states that although the proportion of rye in his mixture was high, the stock ate it all up without its being chaffed. Rye is, however, not very popular with Suffolk farmers—it gets very forward, and sometimes causes trouble with the silage cutters, especially when the lawn mower type of knives are used on the cutter.

A Devonshire Mixture.—Mr. Johnstone-Wallace, Principal of the East Anglian Institute of Agriculture, Chelmsford, informs the writer that he has found the following mixtures give very heavy crops in Devonshire :—

	Mixture A, *bushels per acre.*	*Mixture B*, *bushels per acre.*
Winter vetches	1	¾
,, oats	2	1½
,, rye	⅓	¼
,, wheat	½	½

Mixtures in Hertfordshire.—Mr. R. Rae, Vice-Principal of the Hertfordshire Farm Institute found that of four mixtures

* See this *Journal*, July, 1919, p. 450, and February, 1921, p. 1046.

tried, the heaviest yield per acre was given by 2 bushels of tares, ½ bushel of oats and ½ bushel of rye. Mr. Rae, however, does not regard rye as a very desirable ingredient in a silage mixture on the soil of the Institute, as it gets too forward.

Conclusions.—In view of the very limited number of experiments available and of the varying conditions in different parts of the country, it is impossible to lay down any definite rule as to the best mixture to use. On land in an average state of fertility and under the conditions prevailing in the Eastern and Midland districts a mixture of ½ to 1 bushel of beans, 1 bushel of tares and 1 bushel of winter oats is a very safe one to use. On lighter land the beans might be left out and ½ bushel of rye and 2 bushels of tares sown. Where the silage is made in an unchopped condition, a fair proportion of rye does not matter. The mixtures found successful by Mr. Johnstone-Wallace in Devonshire should certainly be tried, especially in Western districts.

Beans and Peas.—Mixtures of spring beans and peas have long been grown as spring corn crops, and have often given heavy yields of grain and straw. If a suitable mixture is made the crop will usually stand up sufficiently to be cut with a reaper or binder. A mixture consisting of 2 bushels of beans and ¾ to 1 bushel of peas per acre has been found to produce a great quantity of green stuff at Saxmundham Experimental Station, and on the farm of Mr. John Postans, of Hadleigh. It seems highly probable that such a mixture would be suitable for silage purposes.

A mixture consisting of 10 stones of beans, 3 stones of vetches, 8 stones of peas, and 6 stones of oats per acre has been found satisfactory by Professor J. P. Drew* at the Albert Agricultural College, Glasnevin, Dublin. This mixture stood up well, and the stock fed upon it when made into silage throve in a satisfactory way.

Mr. James Cruickshank,† of Cruden Bay, Aberdeenshire, has found that a mixture of 3 bushels of beans, ½ to 1 bushel of tares, ½ bushel of peas and 2 bushels of oats, sown in spring is suited to Aberdeenshire conditions.

There can be no doubt that a mixture of winter beans, with a few tares, could be made which could be sown in autumn and would stand up until it was time to cut the crop. Such a mixture might be found useful in most parts of England.

* *Journal of the Department of Agriculture and Technical Instruction for Ireland*, August, 1921.

† *Scottish Journal of Agriculture*, Jan., 1921.

Beans alone have occasionally been made into silage, and in one case known to the writer gave good results. It has been stated by some, however, that bean silage is not very palatable to stock, and further experience is required. As is well known, spring beans are sometimes so badly attacked by aphides that there is no prospect of a crop of grain. Where this is the case, probably one of the best things to do would be to cut the whole crop, place it into the silo and plough up and clean the land. In this way the farmer would have a good deal of valuable stock food, and would save his land from becoming full of rubbish.

Lucerne.—It has occasionally been stated that lucerne is unsuitable for silage; such, however, has not been the experience of Suffolk farmers. It may not make quite such good silage as tares and oats, but it is quite satisfactory, whether grown alone or mixed with rye grass or cocksfoot.

It also possesses the great advantage of producing a heavy weight of green stuff for a number of years with very little expenditure upon labour or seed. Lucerne should be placed in the silo whilst young and before it becomes stalky.

Sainfoin.—This also has been found quite suitable for silage. Messrs. R. Rae and H. W. Gardner record an experiment with dairy cows in which good results were given with sainfoin silage made in Hertfordshire.* Mr. W. Makens, of Colney, Norwich, has also made sainfoin silage successfully, and there can be no doubt that it is thoroughlv suitable for this purpose.

Clover and Seeds Mixtures.—Under the conditions prevailing in most parts of England, the first crop of clover or seeds is usually best made into hay. It very often happens, however, especially in the Midlands and North of England, that the second crop of clover is not fit to cut until September, when there are very heavy dews and comparatively short days. In these circumstances second-crop clover hay is often partly or wholly spoilt, and there can be no doubt that when there is a danger of this happening it is best made into silage. Clover silage has been found to be of the very highest quality, and in one case on record the feeding of clover silage had an immediate effect in increasing the milk yield of a herd of cows. It is important, however, not to delay cutting the second crop of clover until it is too ripe, or inferior silage will result.

* This *Journal*, June, 1924, p. 261.

Peas and Oats.—The well-known work of Mr. J. C. Brown has called attention to the value of mixed peas and oats as a soiling and hay crop. At the Harper Adams College such a mixture has been found to be one of the best of the crops tried for soiling purposes. Mixtures of peas and oats have been tried by Miss Gillett, Walpole Hatch, Halesworth, and Mr. H. C. Boggis, Wrentham, as a silage crop, and have been found quite satisfactory, the mixture having resulted in excellent silage.

Mr. Brown has found that in order to produce the maximum crop, forage oats giving a large quantity of straw must be used. He recommends Dunn oats—a local variety grown in Cumberland, Westmorland and the West Riding of Yorkshire—as most suitable. The Potato oat, which is widely grown in Scotland, is undoubtedly far superior for this purpose to Abundance and other grain-producing kinds common in most parts of England. In order to secure a heavy crop it is also desirable to include in the mixture a pea with a long straw, such as Maple or Black-Eyed Susan. Mr. Brown has suggested a mixture of 2 bushels of oats and 1 bushel of peas as suitable for soiling, and no doubt this is also suitable for ensilage.

Peas when grown alone for stock feeding are occasionally very badly attacked with aphis or "smother fly." When this is the case one of the best proceedings to adopt is to cut and ensile the whole crop. Peas badly attacked by aphis have been found to yield excellent silage. A considerable area so affected was placed in a silo in 1922 by Mr. J. C. Dimmock, Shotford Hall, Harleston. It was not used until the winter of 1923-4 when it was inspected and sampled by the writer. It proved to be of very good quality, gave a high analysis, and the stock fed upon it throve well.

Sunflowers.—In this country experience of the value of sunflowers as a silage crop is rather limited. When grown at the South-Eastern Agricultural College, Wye, the seed being sown at the rate of 14 lb. per acre, they yielded 20 tons of green material. In 1920 a few acres were grown by Mr. Fred Smith, Woodbridge, and made into silage. Satisfactory results were obtained by feeding two-thirds of a bushel daily to milking cows. Since then sunflower silage has generally been made at Woodbridge. Seven to fourteen pounds of seed per acre are usually sown, and this makes a much cheaper seeding than maize. In one case seven pounds resulted in a thin "plant."

Sunflower silage was made at Cambridge University farm in 1921, and the results, with analyses, were reported by Messrs.

Amos and Woodman in the *Journal of Agricultural Science*, 1923. Sunflower silage has also been made successfully in Gloucestershire, by Mr. S. T. Holland, and at the Cheshire Farm Institute.

At Manitoba Agricultural College, sunflower silage compared favourably with maize silage, when fed to dairy cows, and a similar result was obtained at the Canadian Pacific Railway Company's farm at Strathmore. Sunflowers appear to be quite a suitable crop to grow for silage purposes in this country, and it seems likely that they would thrive in districts too cold for maize.

Maize.—This has proved to be quite a suitable crop for silage purposes in those districts of England where it succeeds as a fodder crop. As is well known, it is the most important silage crop in America. The varieties commonly grown in England for fodder contain too much moisture to get the best results for silage. Mr. A. Amos has found that certain varieties imported from Canada are apparently more suitable for silage in this country than the commonly grown Giant Horse tooth.

Maize silage made in England has been fed successfully to cows and sheep. Thus, of the prizes awarded by the Suffolk Agricultural Association to shepherds in 1923, the first prize was gained by Mr. James Bye, shepherd to Sir George Manners, with a flock of 204 ewes, the average number of lambs to the score ewes, after deducting 3 lambs for the loss of each ewe, being 30.78. During the winter 1922-3, this flock received roughly half a peck of maize silage daily, in addition to turnips, and trough feeding did not commence until the second week in February, although in the district it is usual to commence about Christmas. Maize silage as made in this country more nearly resembles roots in composition than does silage made from the other crops commonly grown for the purpose.

Grass.—In most districts of England grass can be made into hay in an average season without much difficulty, although in a wet season the loss which occurs through damaged hay must be enormous. As far as the writer is aware no serious attempt has ever been made to estimate this loss. In the wetter districts of England, Scotland, Wales and Ireland hay-making is often very difficult and sometimes impossible. In districts of heavy rainfall the advantage of making grass into silage rather than into hay is obvious. There is very little risk of the material being spoilt, whilst the labour involved is probably considerably less than that required to move it about in the field the considerable number of times which are necessary to convert it into hay during a showery spell.

Meadow grass makes excellent silage whether in towers, trenches or stacks. Owing to its close nature it is probably more easily made into stack silage than most other materials; it goes together very closely and air does not gain access very easily.

In moist districts very heavy crops of meadow grass can be obtained by generous manuring, and where this is the case, it may be worth while to use it for silage making rather than grow arable crops for the purpose. In a district of low rainfall this would not usually be the case, as under dry conditions arable crops usually grow two or three times as much greenstuff per acre as meadow grass. Inferior grass can often be made into eatable forage by ensiling it, and cases have come before the writer where coarse grass which no cattle would consume, either green or as hay, has been made palatable in this way.

It is evident, from an examination of the subject, that the British farmer has quite a good selection of crops which are suitable for silage purposes. Much valuable information is accumulating upon the subject of silage making in this country, and it seems probable that silage is gradually becoming a valuable help to the British farmer in the very trying economic conditions through which the industry is passing.

The writer desires to acknowledge the very valuable help given by those mentioned in this article, and by many others who have placed at his disposal the information they have obtained.

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THE CULTIVATION OF NUTS.

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ALTHOUGH the nuts grown in Great Britain comprise walnuts, chestnuts and the group known as cob nuts and filberts, only the two last receive any attention from commercial growers. It is doubtful whether walnuts and chestnuts have been, or ever will be, planted solely with a view to crop production. These trees are primarily planted for ornament or timber, and on acconut of the great length of time which must elapse before they come into a profitable fruiting condition their cultivation for nut production can hardly be regarded as a commercial proposition.

On the other hand both cob nuts and filberts have been cultivated in plantations in Great Britain for close on 100 years and occupy to-day a definite position as a crop of high commercial importance.

This article will in the main deal with the commercial cultivation of cob nuts and filberts, and in particular with cob nuts, these being the most generally grown. Brief reference will also be made to walnuts and chestnuts.

COB NUTS AND FILBERTS.—It is believed that all varieties of cob nuts and filberts have been derived from the common hazel, *Corylus Avellana*, a member of the family *Betulaceæ*. This natural species is indigenous to Great Britain as well as the rest of Europe and Russian Asia.

Little information is available as to the evolution of present day varieties from this wild type, but there is proof that this nut was well known and probably cultivated by the ancient Greeks and Romans. It appears that Italy was the country where development commenced and from which the improved varieties were distributed. So far as Great Britain is concerned, although there is evidence that the wild hazel nut was well known and even planted extensively for various economic purposes, it was not until about 1800 that interest was first aroused in the cultivation of the improved varieties.

With the advent of the fine variety known as "Kentish Cob" or "Lambert Filbert," introduced about 1830, the cultivation of nuts increased tremendously, and Kent, the leading nut-growing county, has now a large acreage planted with the crop. Cob nut growing might well be described as a special Kentish occupation, the trees flourishing in this county exceedingly well, particularly in the Maidstone district.

Soil and Situation.—A study of the soils of Kent where nuts are grown indicates that they do well on the Lower Greensand, Hastings beds and the Tertiary beds overlying the chalk. They are not so much at home on the thin calcareous loams of the chalk and, on the other hand, rich retentive loams are apt to throw the trees into too much wood.

A very useful guide as to soil suitability is the wild hazel. Where this flourishes it is safe to assume that cob nuts will do well. Good drainage seems essential, the best plantations often being found where the rock is very near the surface. For this reason the heavy, moist, clayey loams of the Weald are not very suitable. A good open loam upon a sand or limestone rock is eminently suitable for nuts. At the same time good plantations are seen on the loose, shattery lands of the uplands, below an elevation of 500 feet, providing the land inclines to the south, south-west or west, as the trees dislike bleak wind-swept situa-

FIG. 1.—A Basin-shaped Cob Nut Tree, about 10 years old, unpruned.

FIG. 2.—A similar Tree to that shown in Fig. 1. after pruning

FIG. 3.—Young Cob Nut Tree suitable

tions. Another point is that nuts do well under even dense shade and hence are mostly grown in conjunction with standard trees of apples and plums.

Propagation.—Nut trees may be propagated by layers, suckers, seeds and grafts, but by far the most satisfactory method is by layers. Seedlings should never be employed as it is difficult to ensure the plants being true to type. Suckers, also, do not make the best of trees; and although nuts graft readily this method should only be adopted for special purposes.

Layering consists of bending down the young shoots of the stool bed and covering the bent portions with soil to get them rooted. If this is done in the autumn the layers will be rooted and ready to take up the next autumn. Layered plants consist of straight shoots only, and these, after shortening to about 12 in. are planted out in nursery rows 12 in. apart and 3 ft. apart in the rows. If any of the plants are too weak in the stem they should be cut back to ground level and allowed to spring again, only one shoot being permitted to grow. The object must be to obtain a good straight stem which will serve to carry the framework of the tree.

After a season or two in the nursery quarters each plant should consist of a stem of from 12 to 18 in. carrying a head of six good shoots. The grower must persist by judicious cutting back of the strongest shoots until this number is obtained, as it is these which will form the framework of the trained nut tree. So shaped, the young trees are ready for planting out in their permanent quarters. Fig. 3 is a photograph of a young cob nut tree taken from the nursery bed and at the stage for planting out in its permanent quarters.

Planting.—If the land is intended primarily for a nut plantation a suitable distance to plant will be from 15 to 20 ft. square, but on no account closer than 15 ft. Distance apart depends very much upon the shape the trees are to be trained, but if too close they will suffer from being cramped when fully grown. Each tree should be given ample room to develop so that the pickers and pruners can always get round it comfortably. The tree should go into a good hole and be well trodden in. Staking is not necessary.

Nut trees do not grow rapidly, and if they are to be trained, several years will elapse before they are any size. For this reason the land between the trees may be occupied with soft fruit for ten years or so. Bearing in mind that nuts delight in partial shade, standard plums and apples may be planted through. A

good planting scheme is to set the nuts out say 15 ft. carefully on the square. In the centre of each square plant standard and bush apples, or standard plums and bush apples, alternately. Soft fruit will go in between. As the nuts develop and need more room, the soft fruit and each alternate bush tree can be removed, leaving the nuts and standards to occupy the land.

On the other hand nut trees do very well when incorporated in general mixed plantation schemes such as are fully described in Leaflet No. 148 (Planning and Planting a Fruit Plantation).

Training and Pruning.—Perhaps the most important operation in nut growing is the training of the trees. This calls for skill and judgment, bearing in mind that well-trained trees will last in a profitable condition for upwards of 100 years. Experience has shown that it does not pay to neglect the training and pruning of nuts. The fruit of unpruned trees is smaller and of much poorer quality. Apart from this, money is saved in labour required for picking the crop. In the case of trained trees no ladders are necessary to reach the nuts.

The training system usually employed in plantations is that known as the basin shape. A slightly different system, but based on the same principles, is that known as the plate shape. The object in view in both instances is to train a framework of branches outwards and upwards. The finished tree, in the case of the basin shape, somewhat resembles an inverted umbrella with an average height, when fully grown, of 5 to 6 ft. and a diameter of 8 to 10 ft. In a plate-shaped tree the branches incline more towards the horizontal, and the height will average between 4 and 4½ ft. with a diameter of from 10 to 15 ft., or even 20 ft. Naturally, in the case of the latter training system, the trees must be planted farther apart than in the case of basin-shaped trees.

The actual practice of training the trees is as follows:—During the first year after planting it is advisable not to touch the trees with a knife, but in the second year, assuming that the grower has obtained trees with a head of six well-balanced primary shoots, each shoot should be shortened by one-third or one-half according to its strength—cutting so that the last bud points outwards. The leading shoots of the primary branches must thereafter be similarly shortened every winter, the object being to strengthen the framework as well as to cause each branch to break freely into laterals, which bear the nuts, along its entire length. When the desired height is reached the leaders are finally stopped and from then onwards profuse laterals will be produced.

This lateral growth must be dealt with each year by thinning out and shortening the wood to a fruiting bud. Wood which fruited in the previous year must be spurred right back to 2 or 3 buds. In this way under careful manipulation the trees will maintain themselves in a fruitful condition almost indefinitely. The centre of the trees must be rigidly kept open by ruthlessly removing all suckers (" gormandisers ") which spring from the base.

During the month of August a system of summer pruning is adopted by most nut growers. This consists of hand breaking (not cutting) all the strong sappy lateral growths to about half their length. The object of this practice, which is known as " nut brutting," is to assist the development of the fruiting wood by checking the growth and exposing the wood to sun and air. The winter pruners cut back these broken shoots to the desired length. This practice has a marked beneficial effect on the cropping of the trees. Nuts usually fruit on the 2-year-old wood.

The suckers should never be cut but broken off the stock with a sharp twist. This prevents, to some extent, the subsequent profuse production of suckers. " Spawn," or suckers which spring up from the roots, should be grubbed out with a spade.

Finally, in regard to the proper time for winter pruning, nuts are what are known as monœcious trees, that is to say, there are two distinct forms of blossom borne on each tree—the fruit-bearing or female flowers and the pollen-bearing or male flowers, known as catkins. It is a general and wise practice to delay the winter pruning operations until the catkins have performed their function and the female flowers are fertilised. The small claret-coloured female flowers commence to appear by the end of January and the pollen distribution, weather permitting, will begin about the first week of February. It is safest to defer the pruning until the end of February or beginning of March, but if this cannot be done care must be taken when pruning to leave a sufficient supply of catkins to ensure effective pollination of the female flowers. The accompanying illustrations show:—Fig. 1—a basin-shaped cob nut tree, about 10 years old, unpruned; Fig. 2—a similar tree after pruning. A study of these photographs will indicate the practice of training and pruning nut trees. Note the method of furnishing up the framework of the trees by leaving some of the lateral branches to develop and the

quantity and distribution of the catkins left on the pruned trees to complete pollination.

Cultivation and Manuring.—Cob nuts do not thrive well on grass, and the land beneath the trees must be kept cultivated by digging and hoeing. Its fouling by the growth of couch grass, water grass and perennial thistles must be guarded against. During the earlier life of the plantation horse cultivation will no doubt be possible, but when the trees are fully grown hand digging with 4- or 5-tined plantation forks will be necessary. On no account should the digging be neglected, as this annual cultivation has a very marked effect upon the size and quality of the nuts. Digging should preferably be completed before Christmas, leaving the work rough but burying the weeds.

The manuring of cob nuts is a question upon which no hard and fast rule can be laid down. The grower must study his soil and situation. Experience has shown that the trees thrive best when treated with slow-acting organic manures such as shoddy, fur waste, feathers, etc., rather than with heavy dressings of dung. A special word of caution is necessary on the subject, for as much harm is done by over-manuring as by starving nut trees. Generally speaking, a plantation in its prime and cropping well will require an annual dressing of from 20 to 30 cwt. of any of the above manures per acre. Shoddy is the manure par excellence for nuts, but it should be bought upon analysis quotations as there is considerable variation in its manurial value.

A dressing of lime or basic slag once every three years, is also beneficial. Liming should not be neglected, as owing to the heavy annual leaf fall, etc., the land tends to get sour and the trees will suffer from these conditions. Providing the trees are properly manured and cultivated nuts are not addicted to biennial fruiting and crop fairly regularly.

Harvesting and Marketing the Crop.—Nuts are ready for gathering when the husks commence to turn yellow—about mid-September. It is the practice to pick cob nuts and filberts before they are dead ripe, when the nut readily leaves the husk. As the nuts are marketed in their husks it is found that by picking a little before this the latter cleave to the nuts more firmly. After gathering they are spread out thinly on floors to dry, but when dry they are best kept in bulk to prevent shrivelling. They should, however, be turned frequently to guard against mildew.

Nuts are usually sold wholesale by the cwt. and retail by the pound. They are usually sent to market in half sieves or sieves, which hold approximately 20 and 40 lb. respectively. The best prices are usually realised about Christmas.

Yield.—The yield of nuts may vary considerably from year to year, and is influenced by soil and weather conditions. But, as remarked above, the crop very rarely fails altogether. Although crops of 1 ton to the acre or even more are sometimes grown a fair average yield would be from 10 to 12 cwt. Quality counts, and it pays to make special packs of high quality nuts. No imported nuts of this class can compare with English cob nuts and filberts, and before the war a considerable export trade existed, Germany and Belgium taking large quantities.

Recommended Varieties.—The term cob nut is applied to those varieties having short husks which barely conceal the nuts. The latter are roundish or oval in shape. On the other hand filberts possess long tapering husks usually much longer than the nuts, which are oblong in shape.

Kentish Cob (*Syn. Lambert's Filbert*). — Pre-eminently the best market variety, growing more vigorously and cropping twice as well as any other. Strictly speaking it is a filbert, though known universally as Kentish Cob. Nut large, broad and long, of first rate flavour and, as a rule, completely covered by the husk. Usually produced in bunches of three or four or more. The tree is naturally of vigorous, upright growth, fruiting prolifically, and does not suffer so much as others from early spring frosts. Raised by Mr. Lambert, of Goudhurst, Kent, hence its synonym.

Red Filbert.—Husk long, tubular. Nut, medium sized, ovate, and kernel covered with a red skin. A very old nut which grows and crops well.

White Filbert.—Closely resembling the red filbert save that the skin of the kernel is white. Flavour good. Tree is a good cropper and reliable.

Cosford.—Husk nearly as long as the nut and deeply divided. Nut large, ovate, with a characteristic light brown, thin shell. The kernel is white and of excellent quality. Tree grows well and bears abundantly.

Duke of Edinburgh.—Husk as long as the nut, or longer, coarsely but not deeply fringed. Nut large, oblong, with dark brown, faintly marked shell. The flavour is excellent. Tree a good bearer. This is a first rate tree but most suitable for private gardens where high quality nuts are desired.

Pearson's Prolific.—A true cob nut of value. Husk shorter than the nut, which is roundish, medium sized and of good flavour. The tree is dwarfish in habit, and an early and abundant bearer. It bears catkins freely and is good for planting with filberts as a pollinator.

Merveille de Bolwyller.—Husks shorter than nuts, frizzled. Nut large and broad, of excellent quality. A typical cob nut. Tree grows very vigorously and crops well.

Kentish Cob, Cosford and *White Filbert* are most suitable for plantations. The others are better for gardens where they can be allowed to grow more naturally. Some filberts, especially the red and white varieties, are often shy catkin bearers. To surmount this difficulty catkin-bearing branches of other varieties, or even the wild hazel, may be affixed in the trees to effect pollination. It is a better plan to plant a few good catkin bearers along with the filberts as a safeguard.

Pests and Diseases of Cob Nuts and Filberts.—The following are the principle pests affecting nuts. *Nut Weevil (Balaninus nucus)*.—A highly destructive pest, often materially reducing the crop. The adult weevil, which appears about mid-June, pierces the young nuts with its ovipositor and deposits an egg within. The maggot feeds upon the kernel, usually causing the nut to drop prematurely. The maggot then emerges and passes the rest of its larval stages in the ground, emerging as an adult the following year. Shaking the trees over tarred sacks or boards to collect the beetles, ample and thorough cultivation of the soil in winter, together with washing the trees with lead arsenate in June and July, have been found useful remedies against this pest.

Winter Moths.—In common with other fruit trees, nuts have to submit to the depredations of the winter moth larvæ. Not only do they devour the foliage but even gnaw the young nuts and ruin them. Spraying with lead arsenate or nicotine washes and grease banding the trees (although nut trees do not lend themselves readily to this operation) as described in Leaflet No. 4 (Winter Moths) are recommended.

The Nut Bud Mite (Eriophyes Avellanæ).—Although there is no connection between the two, this mite causes damage to nut buds similar to that done by the currant bud mite to black currant buds. The swollen buds may be observed in winter, and are usually damaged beyond recovery. Fortunately it is the leaf buds only which are attacked. Hand picking of swollen buds and the precaution of planting only clean stock are about the only combative measures.

Other pests of minor importance are the *Buff-Tip Moth*, the larvæ of which devours the foliage; the *Nut Leaf Blister Moth*, which causes large pale blisters on the leaves through its burrowing larvæ, and the *Nut Sawfly*, whose larvæ are sometimes found devouring the foliage.*

The only fungus disease attacking cob nuts and filberts is the common hazel mildew, but the damage done is usually of a slight nature.

* See *Insect Pests of Fruit*, F. V. Theobald, 1919.

WALNUTS AND CHESTNUTS.—The walnut (*Juglans regis*) is a monœcious tree, a member of the family *Juglandaceæ*, and, although not indigenous to Great Britain, being a native of Persia and Asia Minor, it has been extensively planted in the past. It seems probable that the Romans first introduced it, although nothing definite is known. The tree grows to an immense size and is esteemed for its timber and ornamental value as well as for its fruit. Ripe English walnuts sell well in the markets. The fruit, while still young and tender, is also often gathered and sold for pickling purposes. More careful attention might be given than is frequently now exercised to gathering the green nuts when in the best condition for this use, *i.e.*, before the nuts become woody and while they may still be readily pierced by a needle without the soft shell which is forming inside the husk being felt—usually towards the end of June or early July. This would ensure a considerably larger proportion of this extensive demand being met by home-grown walnuts in substitution for foreign importations. The production of green walnuts for this purpose is feasible over more northerly areas than is that of the ripe nut.

The walnut thrives well in deep sandy loams and tolerably well in calcareous soils and heavy loams on gravel. It dislikes solid chalk, peaty soils and damp situations generally.

Propagation and Cultivation.—Propagation by seeds, budding and grafting is practised, but the best trees for timber purposes are produced from seeds, which should, wherever possible, be planted in their permanent location. Grafting or budding special varieties, however, on good vigorous English walnut stocks, should always be resorted to where the nut crop is the chief consideration. In planting nuts for timber or for stocks it is the practice to select good sized nuts and bed them in sand in a cool shed until the following February or March when they are set out in nursery rows 12 in. apart on deeply worked well manured land. The rows should be 3 ft. apart. The young trees should be transplanted every two years, planting farther apart and pruning the main roots on each occasion. Trees of 5 or 6 years growth are usually selected for planting out permanently. Staking is advisable.

The walnut is less easy to graft than most fruit trees. Considerable experience has, however, been accumulated on this point, especially in North America and in France. In California over 100,000 acres are now under walnut orchard. Young stocks of ½ in. to 1½ in. diameter are usually employed and are grafted

close above the ground, using a cleft or modified cleft graft. For larger stumps and top working a bark or side graft is frequently used. Thoroughly dormant scions are best for the purpose.

Some references to literature containing descriptions of American and French methods and cultural practice are given in an appendix (p. 658). There are many seedling walnut trees in this country, particularly in the midland and southern counties, which could advantageously be top worked to superior varieties from the point of view of nut quality and yield. Grafted trees come into bearing several years earlier than seedlings, and with already established trees as stocks the crop value could be much increased. The Ministry is desirous of locating any walnut tree of merit, and a brief description of any such tree with particulars of the quality of the nut and average crop would be welcomed.

As walnuts will shape themselves naturally, little pruning is necessary beyond the encouragement of a straight stem. The trees do not like the knife, and any cutting which is necessary is best performed in the early autumn before the foliage is off.

Harvesting.—The fashion of thrashing the trees with sticks at harvest time has nothing to recommend it and should be discouraged as walnuts are susceptible to ill-usage. Where necessary long polished rods with a rubber or cloth covered hook for shaking the branches may be employed. The nuts when ripe will mostly drop, and may be collected at intervals. The nuts should not be allowed to lie any length of time before being gathered, and husked if necessary, as otherwise they become badly stained and dark and are much more susceptible to mould development. Before being sacked they should be spread to dry out excessive moisture and turned occasionally.

Tremendous quantities of walnuts are imported into this country from the Continent. Nevertheless, despite the length of time the trees occupy before becoming fruitful. they grow so well and usually crop so abundantly that the planting of them is well worth the attention of land-owners. Apart from the yield of nuts the timber is most valuable, and the tree is a good ornamental shade tree.

Varieties.—*Common Walnut.*—As this tree is usually grown from seed the fruit is found to vary considerbaly in size, quality, yield, etc, The better quality walnuts are usually worked upon it when the seedlings are two years old. If left to grow themselves the trees are vigorous and usually fruitful.

Dwarf Prolific.—Has the reputation of coming into bearing at an early age, often when only 3 ft. high. The quality is good but the tree is not a vigorous grower.

Large Fruited.—A large nut with deeply wrinkled shell, one and a half times to twice as large as ordinary walnuts. It is disappointing in that the shells are not well filled and the nuts do not keep very well. It is, however, an excellent nut when eaten in the fresh milky condition. A variety of this nut (the Gourlande) is grown in France solely for use in confectionery purposes in the fresh state. It is known locally in Shropshire as the Bannat and in favourable years crops heavily.

Chestnuts.—The Chestnut (*Castanea sativa*), a member of the family *Cupuliferæ*, is a native of the Mediteraranean region. Introduced into Great Britain by the Romans, it spread far and wide, assisted no doubt by the freedom with which it reproduces itself from seed. On account of its ability to sprout from the stump after cutting, it has been specially cultivated for centuries as underwood on account of its timber value for fencing, hurdle making, hop poles, etc., but little attention has been given to it as a food-producing tree. In France and Italy, however, chestnuts have been specially cultivated for the yield of fruit for hundreds of years, and concentration on the improvement of varieties has produced good results.

Chestnuts succeed well on sandy soils, disliking chalk and calcareous formations. They fare tolerably well on clay and other stiff soils if the drainage is good, but the trees prefer to stand on a dry subsoil. Although the trees grow well from seeds in a natural state the best cultivated varieties are budded or grafted upon seedling stocks. Moreover, whereas a seedling may occupy from 15 to 20 years before fruiting, grafted trees fruit as early as from 4 to 8 years after being worked.

The nuts are best sown in February or March after spending the winter in sand. They must be placed 6 in. apart in rows 3 ft. apart and covered with 3 in. of soil. When the seedlings are two years old they are given a move, shortening the roots and planting 12 in. apart in rows. They are now ready for budding and grafting but whether they are worked or not before being grown on for trees they must be transplanted every two years until the stems are about 1 in. in diameter. They can then be planted out permanently at about 40 or 50 ft. apart. A little pruning is necessary to encourage the formation of well-balanced trees with straight stems. The trees are not intolerant of the knife as are walnuts. The nuts when ripe fall to the ground, where they can be collected from time to time.

Varieties.—*Darlington.*—An American chestnut of good quality. Tree vigorous and fruitful.

Paragon.—Also an American variety. Nuts large, juicy and sweet.

Devonshire Prolific.—Reputed to be the most abundant cropper and matures its crop regularly.

In addition to the above, which have been tried and found satisfactory, there are many French and Italian varieties, especially those classified as *Marrons* (a group reputed to be larger, sweeter and more nutritious than ordinary chestnuts), which should be worth a trial.

Insect Pests and Diseases.—There are no serious pests or diseases of walnuts and chestnuts in Great Britain, but Theobald records the nut fruit tortrix, the common walnut louse (an aphid), the leaf box beetle and the walnut leaf gall mite as doing a certain amount of injury (Insect Pests of Fruit, 1909). Anthracnose, which is frequently found on the leaves, young shoots and buds of walnuts, and shows in grey-brown or blackish patches, causes no serious trouble.

Mention might be made of the very serious disease known as chestnut canker, *Endothia parasitica*, which has devastated the trees of the United States. It has, fortunately, not so far appeared in this country, but constant watch should be kept for it. This disease produces large reddish cankered areas on the trunks of the trees. These cankered areas spread and often completely girdle the tree. The foliage of diseased trees becomes a sickly yellow in colour and the tree is eventually killed. The cankered areas usually become covered with numerous small pimples which are the spore-producing bodies. Watch should be kept for symptoms of this nature among chestnut trees and any suspicious dying back should be investigated by experts.

Appendix—Publications on Walnut Growing—

Le Noyer (F. Lesourd). Librairie Agricole de la Maison Rustique. Rue Jacob 26, Paris 6e.

De la Culture du Noyer en France (J. Arltrand-Berltret). Annales de l'Institut National Agronomique, 2 Sec., Tome II, 1903. Rue Jacob 26, Paris 6e.

Walnut Culture in California (R. E. Smith). University of California. Bulletin 231, 1912.

The Persian Walnut Industry of the United States (E. R. Lake). Bureau of Plant Industry, Bulletin 254, 1913.

Walnut Culture in Arizona (J. J. Hunter). University of Arizona. Agricultural Experimental Station, Bulletin 76, 1915.

Nut Growing (R. J. Morris). The Macmillan Company, 1921.

Reprint Leaflets on Nut Culture. American Fruits Publication Company, 398, State Street, Rochester, N.Y.

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UTILITY DUCK KEEPING.

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COMPARISONS are often made between the respective merits of ducks and fowls, which tend to show a prejudice in favour of the one or the other. Such discussions are not of much value. Fowls and ducks have, or should have, each their own place in the economy of the farm, the small holding, or the cottage garden, and the question should really be, which are the most suitable to keep under particular conditions, or whether even both may not profitably be installed side by side as complementary to one another.

Clearly there are certain conditions where ducks would flourish whilst chickens would die, and *per contra*, where ducks would be most out of place and profitless, but chickens perfectly suitable.

It is the writer's intention to put forward in the following article a few reasons why ducks are peculiarly suitable to certain conditions. Before, however, passing to practical duck keeping a few remarks on the development of the industry during recent years may be interesting.

While ducks have for many years been kept in a haphazard kind of way on a large number of English farms, it is only within very recent years that correct management, feeding and breeding, have been at all carefully and generally practised. Looking through the back numbers of the Utility Duck Club Year Book, it is instructive to note that only five years ago, trap-nesting or recording the individual performances of ducks was almost entirely unknown. If the 1924 Year Book of the same Club is referred to, numerous advertisements will be found of breeders who trap-nest their birds and who have strains bred from winning pens in one or other of the public laying tests where ducks are regularly trap-nested.

It is now realised that if a bird is to lay eggs it must be furnished with the material out of which to make them. The experience of the last few years has taught us what are the best foods to give, in what quantities and how to give them, besides much other useful information. At the same time trap-nesting and the careful selection of stock birds has made it possible to develop reliable strains of winter-laying ducks. This information has been stored up by the Utility Duck Club, a society formed some years ago by a small body of enthusiasts,

and it is now available to anyone who cares to take up duck keeping, either on a large or small scale.

One fallacy needs to be removed at once. It is thought by many that ducks cannot be kept without swimming water. This is quite a wrong assumption. The laying breeds of ducks do not require swimming water at any time in their adult life, including the breeding season. On the writer's own farm a flock of 500 ducks was kept last season, and they were purposely prevented from reaching the ponds. It would take too long to discuss the reasons and advantages of this, but they are sufficiently weighty to make it an inviolable rule that ponds are out of bounds, except for very young birds.

The next point to be mentioned is that the cost of housing is very low, elaborate and expensive housing being entirely unnecessary. Of course, when it comes to trap-nesting, costs must necessarily go up very considerably, but for the main part, this may be left to the pedigree breeder, though the advantage of practising such a method of selecting stock is so great that it should be followed wherever possible.

It must also be remembered that ducks have one very peculiar characteristic—a duck of good strain, well managed, will lay the most extraordinary sequence of eggs. Sequences of over 200 eggs, without a break, have been recorded at the public laying tests, sequences of 100 eggs or more are quite common, while the ordinary bird will usually lay sequences of 20-30 eggs, miss a day and then carry on. It will easily be realised what a valuable characteristic this is in a bird which begins to lay, say in the middle of October and carries on right through the winter when eggs are 3½d. or 4d. each. It must, however, be borne in mind that they are nervous creatures, and that these performances may easily be ruined by mismanagement or mishandling.

Handling Ducks.—As a general axiom it is well to lay down that ducks should be handled as little as possible, but if it is necessary to handle them at all it should be properly done, and the following information may be useful to any who may be encouraged to keep ducks. Fig. 1 shows how a bird should be caught, *i.e.*, by the neck. This is the least damaging and simplest method to employ.

From the position shown in Fig. 1 the bird should be lifted off the ground—still by the neck. It will immediately flap its wings, and the right procedure is then to slip the other hand into the position shown in Fig 2, where the wings are

FIG 1.—Showing the Method of Catching the Duck.

FIG. 2.—Showing the Method of Lifting the Duck.

FIG. 4.—Front View, showing Method of Holding the Duck for Attention to its Legs or Feet.

FIG. 5.—Rear View showing the Wings of the Duck held between the Legs of the Holder.

grasped at the root, between the thumb and fingers. A caution is necessary here, for the bird—particularly if it is a drake—will often make the powerful wing muscles rigid so as to try to hold the wings in an outstretched position. It is wrong to attempt to force them together; in a moment or two the muscles will relax, when the wings may be folded together and the bird comfortably held.

Fig. 2 should be regarded merely as a temporary method of holding the bird. If it is to be carried any distance, it should be placed in the position shown in Fig. 3. Here the bird's stomach and breast are resting comfortably on the palm of the hand, and in this position it will remain quietly, without struggling in any way. Figs. 4 and 5 show a single-handed method of managing a duck if it is desired to ring it, or attend to its feet or legs. The position is not elegant, but it is a simple method of accomplishing an otherwise almost impossible job without an attendant. The folded wings—as the photo (Fig. 5) shows—are placed between the legs of the operator, and if the knees are then bent slightly, it is possible for the bird to rest quite easily on its back, leaving both the hands of the operator free to deal with feet and legs.

The importance of handling birds properly, and at the same time obtaining their confidence and making them tame, cannot be exaggerated. As with most animals this may most easily be accomplished at feeding times.

Conditions Suitable for Ducks.—Who are those to whom it would be profitable to keep laying ducks, and what are the most suitable places for them? The answer to the first part of the question is really very simple. It should be profitable for anyone who has enough space available to put ducks on it. This really covers the answer to the second part of the question also. However, to go into a little more detail. The general farmer usually runs a few chickens, and it would be very easy for him to run a few ducks as well. Probably he has an empty cart lodge, a disused pig pound, or rough open shed: no perches and no fittings of any sort are necessary, and if foxes are troublesome, a little wire netting to baffle them is all that will be needed. This housing will have cost nothing, cavings or any rough stuff will serve for litter, or this can be dispensed with altogether. At nine o'clock in the morning, or thereabouts, certainly not before, for the eggs would then be lost, the birds can be let out. After a light meal they will amuse themselves all day running the pastures or stubbles

till the evening, when they will return as regularly as clockwork for their last meal. Should there be pigs on the farm it is quite certain that there would never be anything left in the troughs, for the ducks would see to it that no waste occurred.

Equally suitable places are the fruit farming districts, such as the cherry and apple orchards of Kent.* At first sight the housing problem might appear a little more complicated, but it may be solved easily and cheaply by the use of a few hurdles thatched with straw to form a rough shelter, though as housing is really a subject to itself, it cannot be touched on further here.†

There is substantial reason to believe that ducks have a very beneficial effect in orchards, for they are indefatigable in the consumption of insect life, and they do not climb trees or damage the fruit. The writer has watched young ducklings standing underneath an apple tree and catching insects as they made their way up the trunk, while a considerable difference has been noted in the number of insect pests among trees where ducks have been run, as against those where there were none. They are most useful, too, in the destruction of slugs. In fact it might well be maintained that no one would benefit more by keeping ducks than the fruit farmer.

After the fruit farmer, come the small-holder and the private person. The former has perhaps a rough corner of ground on which nothing will grow, a place devoted to the growth of weeds, or boggy and useless for all ordinary stock. In just such a place will the duck thrive and produce profit where no profit was before.

Lastly, there is the private person who does not keep poultry for profit, but as a hobby or to supply his household with eggs. He or she often possesses or has a lease of a little orchard, or paddock, which, with the outlay of a few shillings would make it an ideal place to run as many ducks as he would ever be likely to want, for a space of about 15 to 20 yards square will keep a pen of half-a-dozen ducks happy, nor is there need for high wire netting. If the neighbours object to the ducks calling on them, a piece of 2 ft. or 3 ft. netting will check their sociable instincts.

Any of those who have been mentioned, and probably many others whose individual cases do not fit exactly to the examples given, would find ducks profitable, provided simple methods

* Poultry Keeping and Fruit Culture, this *Journal*, September, 1923, p. 539.
† Notes on Poultry Keeping, this *Journal*, June, 1924, p. 278.

of good management and good feeding were followed. Apart from this side of the question, the birds would be found extremely interesting to keep; they are most intelligent and well repay any attention they get.

Our villages already hold their flower shows, baby shows and so on: it might well be worth while to start small live-stock competitions with prizes for the best kept, best managed poultry (including ducks), rabbits, and so on, with special marks for ingenuity in the construction of houses, and cheapness of building methods employed. Possibly such competitions might engender a greater love for the free life of the country, and open out, in some cases, the possibility of a career for some of the youngsters for whom it is so hard to find employment.

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THE LAPWING.

H. MORTIMER BATTEN, F.Z.S.

EARLY last spring the subject of the disappearance of the lapwing was brought forward by Sir Herbert Maxwell, Bart., and other eminent naturalists, and since then the opinions of practical observers from all over the country have poured in to the sporting and daily press. Never before within the writer's memory has the immediate preservation of any wild bird been so whole-heartedly urged—the reason being, of course, that the lapwing (or green plover, or peewit) is of great value to agricultural interests. The bird is entirely insectivorous, and tends to reduce many harmful insect pests—harmful, that is, to crops, or as disease-carrying agencies where live stock is concerned. Many people are inclined to question whether the lapwing really is disappearing, or hold sceptical views of other kinds as regards its complete preservation, but no question has been raised as to its value to the country. Therefore, the main issue is not affected by these counter opinions—that we have in our midst a bird which is of great value to mankind, and which, therefore, should be preserved and allowed to multiply unchecked.

Having this accumulation of data before us, the time is appropriate for reviewing the outstanding facts regarding the present status of the species.

In the first place, whatever may have been written to the contrary, there can be very little doubt that the lapwing *is*

disappearing, and that unless steps be taken it will, in a very few years' time, be among many other wild birds which are similarly useful, but which exist in such small numbers that they are not worth reckoning. Always the lapwing works for good, but unless its numbers are sufficient the total benefit is negligible. In other words, the lapwing as a plentiful species is very much worth while, but as a rare bird, such as it threatens to become, it will sink below notice.

The writer has received letters from observers in many parts of England and Scotland concerning the lapwing's breeding haunts. All tell practically the same story. The following is an extract from a typical letter:—"In my boyhood, twenty years ago, I used to walk over these moors on my way to and from school, and daily, during the plover-egg season, I returned with my cap filled. This year and last, covering the same ground, one was hard put to it to find a single nest. During a twenty-two mile walk last April I picked up only eight eggs, and each year they are becoming rarer. Unquestionably the lapwing is going."

Cause of its Disappearance.—Admitting that this bird as a breeding species—and it is from the breeding birds that we obtain the greatest benefit—is going, what are the causes of it? In the first place, the taking of eggs.

The plough, the chain harrow, the roller, and floods undoubtedly claim great numbers of eggs over vast areas, but these conditions have prevailed for many years. If, twenty years ago, the lapwing could hold its own against such activities, it could do so to-day, so we must look further. Eggs have long been regarded as a delicacy, but probably ten times as many are consumed to-day as a few years ago. In every town of any note they are to be seen on sale during the spring, quite regardless of the alleged close season. All over London they are displayed. I have seen as many as one hundred plover eggs set up in a single poulterer's shop, a second shop across the road, having almost as many. If this be multiplied all over the city and all over other cities, the aggregate is appalling. Could any wild bird stand such a drainage? In addition thousands of eggs are sold direct to the hotels, appearing as a standing feature on the menus.

It may be said that the bulk of this supply comes from the Netherlands, which is quite true, but nevertheless our own resident lapwings are responsible for a proportion which taxes the stock to the utmost. In my own locality it was possible,

FIG. 1.—Lapwing. Male bird distinguishable from female by the spot on its throat.

FIG. 2.—Lapwing. Female bird and eggs.

only a few years ago, to purchase all the eggs one wanted at a penny apiece or thereabouts. Not so to-day. The local grocer purchases every egg he can lay hands on at a price we would not give, and the eggs are shipped out in box loads. Every schoolboy, anxious to earn a little pocket money, spends his spare time plover egg hunting—and indeed it is worth while for any country boy, since the eggs have a high market value at all times. By no other means is he afforded an equally good opportunity of earning pocket money.

Prevention of Sale of Eggs.—In the writer's opinion the protection of the nests, and the nests only, after mid-April, is useless. So long as it is legitimate to display the eggs for sale during the close season, the demand for them remains, and the only way to preserve the eggs is to remove the demand, which is the market value. If it is illegal to lift plover eggs after 14th April, it should be illegal to sell them after 18th April, this giving the dealer four days to clear his stock.

In the wilder regions, where lapwings breed most numerously, it is impossible for the police to protect their nesting haunts—even if the police are so disposed, which they rarely are. The breeding haunts of the bird are too wide and too varied to obtain any practical benefit from legislative protection. To enforce restrictions concerning the sale and shipment of eggs, however, is a very simple matter. Few tradesmen whose business is worth while would risk their prestige for so small a matter. I repeat, therefore, that the only way to effect the protection of the birds is to limit the sale of eggs.

Admitting that the prohibition of the sale of eggs is an essential point, the question then arises as to whether the taking and sale of eggs should be entirely prohibited or whether it should be allowed up to a certain date. The writer is all in favour of the latter course, because total prohibition might encourage secret collecting. There are many who regard plover eggs as the first dainty of the season, and who are prepared to pay for them. There are others who, for years, have looked forward to the early days of plover egg collecting as a seasonable sport. Give these people a chance of satisfying their first desires and they will rest content, but impose a distasteful restriction, and we are up against an old difficulty.

The main point, however, is that the lapwing, as a species, loses nothing by the lifting of its first clutch. Tens of thousands of these eggs, if not lifted and put to a useful purpose, are destroyed by floods, agriculture, or chill. Very

few of the early clutches produce a full complement of chicks. If a lapwing is seen with offspring during the early days of May, it is generally one chick she is sheltering, rarely two. Now, had that bird's first clutch been lifted, she would have laid again immediately, and instead of bringing off only one chick she would, with the later season in her favour, have brought off three or four. Again, that single early chick is just as likely as not to perish by heavy rain, whereas chicks hatching a few days later have a better chance of survival. Over and above this I know from personal observation that scores of birds spend half the season sitting chilled eggs, laid during snow and sleet, and so, instead of hatching two broods they hatch only one. Had the first eggs been lifted there would still have been time for the bird to bring off two broods under healthy conditions.

These, however, are merely the views of the present writer, while, on the other hand, many competent authorities, who are not merely arcadians, maintain that the only way to help the species is to preserve it and its nesting haunts at all times. Certainly little could be lost by so doing, and a great deal might be gained.

Preservation of the Birds.—The question next arises as to whether the adult birds should be preserved in winter. The consensus of opinion is that they should be preserved. There are, however, many who maintain that such a provision is superfluous, since our flocks of winter lapwings are merely migrants, and that no amount of preservation will induce them to remain over the nesting season. They also suggest that these migrants are in such numbers that the few that fall to the gun is a negligible quantity.

All this is quite true, but if we are to preserve a species we may as well preserve it properly. Our resident birds are not our true source of supply. If every lapwing which nests overseas were shot, we should very soon have no lapwings, no matter how rigorously we protected our breeding birds. It therefore seems to me to be very shallow reckoning to strive to preserve our local stock but permit the destruction of the source from which that stock springs. If, on the other hand, the lapwing were preserved throughout Europe, we should reap the benefit.

Other causes which have brought about the failure of this bird to retain its footing are worthy of notice. Farmers would help the species considerably if, instead of allowing several days

to elapse between harrowing, sowing and rolling, they hastened these processes. Generally, there is a sufficient (and quite unnecessary) lapse of time between one process and the next for the birds to re-settle themselves on the land, with the result that fresh sittings are destroyed.

In dry regions improved drainage leads to tremendous loss among the chicks, since, owing to the dryness of the land, there is insufficient insect fare for them. What improved drainage takes in one way, however, it gives back in another, for vast areas which were once subject to inundation in the spring, are now so well drained that few chicks are drowned or nests flooded. Of course the birds have forsaken, owing to improved drainage, great areas which were once breeding haunts, but they are not like the snipe and the curlew, which must be able to dig their bills into the ground in order to obtain their food. Lapwings can flourish on hard ground so long as they can obtain sufficient insect food, so that the swampy waste is neither necessary nor, on the whole, desirable for their welfare.

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OCTOBER ON THE FARM.

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The Weather.—October, really the beginning of the farmer's year of operations, forms the middle period of the autumn quarter; but normally it resembles November more than September. The days shorten; the daily duration of bright sunshine is small: there is a marked fall in temperature and night frosts begin to occur. With a normal mean temperature of 48° F. in the Midlands, grass, swedes, cabbages and weeds of the "twitch" class continue to grow, and the soil is warm enough for the quick germination of sown corn and for the tillering of corn that is already above the ground; but potatoes die down, mangolds add little to their weight, and cattle begin to lengthen their coats.

The records of rainfall in the various months show that, on the average of the years 1881-1915, October has been the wettest of the twelve. In 1920 and again in 1922, however, this month included a long dry period—which condition doubtless most farmers earnestly hope will prevail this year. October is not a cleaning month; its chief land operations are the sowing

of wheat, beans, winter oats and ensilage crops, and the harvesting of potatoes and mangolds.

Soil Management.—The knowledge which guides farmers in their methods of preparing land for the various crops is partly customary and traditional, and partly derived from individual experience and observation. Research in the relationships between soil conditions and crop growth has not yet reached the stage of providing specific guidance on all points in soil management. Accurate knowledge of the optimum soil conditions—depth, firmness, fineness, aeration and moisture content—in the tilth for each of the common crops would be invaluable and possibly suggest economies in the tillages usually considered necessary.

Pre-arranged cultivation experiments are not easily conducted on ordinary farms; but many unintentional trials of different methods of preparing land are carried out by farmers, the results of which, if collected and co-ordinated would be of value to others—both practical growers and research workers. Two Derbyshire cases of the kind in question, which may be of interest at this period, are here recorded :—

(*a*) *Wheat after Mangolds.*—In November, 1921, half of a field of mangold " stubble " on free loam was ploughed with a lea breast, turning an unbroken firm furrow; while the other half was ploughed with a digger, which broke the furrow down. Wheat was immediately disc-drilled over the whole field and finished with one stroke of the seed harrows. Contrary to the farmer's anticipation, the crop wintered best on the digger work; and in March, 1922, the growth on this half of the field was distinctly earlier than that on the half which had been lea-ploughed.

(*b*) *Winter Oats after Spring Oats.*—In October, 1921, the greater part of an oat stubble on heavy land was ploughed flat with a digger breast, while the smaller portion was utilised by the farmer's son in practising with a lea plough for an impending ploughing-match. The whole area was drilled at the end of the month with winter oats. The results in this case were decidedly in favour of the lea-type of furrow, the farmer estimating the difference at two sacks per acre.

In comparing the above two cases, regard should be had to the difference in land and to the fact that (*b*) was in a colder and wetter district than (*a*).

Wheat Sowing.—In many districts a five-course rotation is followed in which " seeds " are succeeded by oats and the latter by wheat. The preparation of the oat stubble for wheat

sowing receives priority in the autumn tillages; and, where the rules of good husbandry can be and are observed, the oat stubble is both cleaned and manured before being re-sown with a straw crop. In view of the lateness of the harvest and the sodden state of the land during August and early September, it is likely that this autumn much land will have to be drilled without first being properly cleaned. It is important, however, that manuring be not omitted, otherwise the expense of cleaning after the resulting wheat crop may be greatly increased. Where yard manure has not been applied before ploughing, a complete dressing of artificials should be harrowed-in with the seed.

Early sowing is an important factor in wheat growing; the seed bed should not be made too fine on the surface; the depth of drilling may be about 2 inches at this time of the year; and from 10 to 12 stones is a suitable allowance of seed, the actual quantity depending on size of seed, variety, and soil conditions. In view of the fact that many farmers still dress their seed-wheat with strong solutions of copper sulphate, which reduce the germinating capacity of the seed and both weaken and delay the braird, mention may again be made of the better dressing for the prevention of bunt (or " smut " as it is often wrongly named), *i.e.*, formalin.*

Wheat Varieties.—The farmer is urged to believe that the choice of the right variety is a potent factor in wheat production; his difficulty, however, is to obtain reliable information as to which of the many kinds is likely best to suit his conditions. The results of variety trials appear to be very erratic: they differ at the several centres in the same year, and the order of merit at the same centre is not similar in successive years. Many experiments would have been more useful if one of the plots had been duplicated, to indicate what difference in yield the same variety might have produced on another plot.

From the results of several years' trials in Derbyshire and a perusal of the reports on experiments in other counties, the writer has arrived at the following conclusions:—

Two of the most reliable varieties of wheat for all soils and districts are *Victor* and *Standard Red*. These two may, under certain conditions, be excelled in yield by Rivett wheat, by Swedish Iron or by Yeoman; but the former are not so subject to failure, or loss of plant in winter and subsequent weediness, when drilled late or when grown under unfavourable conditions. *Victor*, a white wheat, is somewhat shorter in straw than Stan-

* See the Ministry's Leaflet No. 92.

dard Red and stands up rather better. In the south-eastern counties Victor yields the heavier, and in Derbyshire it has invariably surpassed its red rival; at Garforth (Yorks), however, the two have over a long period averaged about the same. *Standard Red* is a popular red wheat of very good milling quality and it is not so subject as Victor to sprouting in a wet harvest. Possibly this variety should be preferred to Victor when sowing as a second corn crop and on land not in high condition.

Squareheads Master is very similar to Standard Red. *Bearded Red* is another good variety for late sowing and for use where sparrows are troublesome: its grain is of very good quality. *Little Joss* is another hardy variety, but it is too weak in the straw for rich land or moist conditions. It does very well in the eastern counties.

Yeoman excels in milling quality, and also in strength of straw—an important consideration for the farmer who desires to make the best use of artificial manures. On good land and when sown reasonably early it yields very heavy crops. A 5-acre field of heavy land yielded 42 qr. of best corn of this variety on the County Asylum Farm, near Derby, in 1923. The same seed sown at Bolsover, near Chesterfield, at 550 ft. elevation, yielded 56¾ bushels per acre of best grain as compared with 49 bushels on the adjoining control plot of Standard Red. At Garforth (Yorks), however, Yeoman has not, on the average, equalled Standard Red.*

Iron is probably the most productive of all the varieties of wheat grown in England, and the straw, although lengthy, stands well. The defects of Iron and Iron II were lateness of ripening, inferior quality of grain and their liability to perish in winter. At Sutton Bonington (Notts) Iron II sown on 13th December, 1923, perished completely, but Iron III survived, though by the end of February it was only about half as thick on the ground as Standard Red. The third strain of Iron is also earlier than its predecessors.

Winter Oats.—As a rule good strong land that is ready to sow in October should be sown with wheat in preference to winter oats. For cattle feeding purposes, 4 qr. (18 cwt.) of wheat grain are equivalent to 7 qr. (21 cwt.) of oats. For selling purposes, however, no comparison applicable to next harvest can be made: on this season's prices it would require about

* A note on the new wheat, Yeoman II, appeared in the September issue of this *Journal*, p. 509.

8 qr. of oats to equal 4 qr. of wheat. On rich land, winter oats are subject to lodging, but another reason for preferring wheat for the autumn chance is that winter oats can be sown with excellent results after the best time for wheat drilling has passed.

On poorer land, black or grey winter oats or winter barley may be preferable to wheat for October sowings, especially where the soil is short of lime; but white winter oats require good conditions; and if the weather subsequent to sowing should resemble that which prevailed in 1923-24, October in many parts of the country would be a very risky month in which to drill white oats.

Replies from farmers who kindly communicated their last season's experience and observations on white winter oats show that in the northern and midland counties many autumn sowings of this crop, after coming up quickly and evenly, perished during the winter. The greatest loss of plant took place about February, which is remarkable in view of the fact that February sowings proved so successful; some crops had, however, perished by the middle of December. From the north-eastern counties twelve complete failures of autumn sowings were reported, but one excellent crop on a field of heavy land was grown by a correspondent in the East Riding of Yorkshire who drilled on 25th September. In the western midlands also there were many failures on both light and heavy soils, even crops reported as "sown very early" perishing in February. A Herefordshire farmer supplied particulars of a fertile field of strong land (beans in 1923) drilled on 2nd October, white winters being sown on three acres and blacks on four acres. The blacks wintered well, tillered out too thickly after top dressing in March and ultimately lodged. The whites, however, died off in large patches during January.

A Suffolk correspondent states that on 30th October he drilled a field of rather wet boulder clay, after bare fallow, part with whites which yielded only 4 sacks per acre; and part with blacks, which made an average crop of 10 sacks per acre. Another field, after peas, on well-drained ground, was drilled with whites on 15th October, and this crop, although thin, yielded 10 sacks per acre. Both crops were top dressed in March. He mentions that the fallow had become too fine on the surface, and that he thinks drainage is an important factor; he further mentions that white winter oats will not bear harrowing in spring. These observations all bear on the question of "throwing out."

In Derbyshire most of the October sowings of white winter oats failed, although blacks sown at the same time survived. The weather in October was, however, unusually mild, and the November and December frosts played havoc with the half-established seedlings that had germinated under the comparatively mild conditions: the seedlings were "thrown out." Sowings made after the cold weather had come succeeded, even where the seed lay many weeks in the ground before germinating.

The writer has had under observation eight variety trials and several other crops of winter oats sown at various elevations up to 850 ft. and at various late dates from December to March. Information regarding the results of these will be communicated in subsequent notes; but it may here be mentioned that excellent crops of all varieties including whites were grown even at elevations above 700 feet, when sown in January and February, as suggested in this section of the *Journal* during those two months.

* * * * * *

MANURES FOR OCTOBER.

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Rothamsted Experimental Station.

Fertiliser Requirements.—Having decided on the cropping scheme for the coming farm year it is desirable to make an estimate of the quantities of artificial fertilisers which the crops will require. Early attention to this matter will enable the farmer to purchase at more favourable prices and obtain prompter delivery than he is likely to secure later in the season. In the case of a farm where occasional dressings of lime are needed and the land is responsive to potash, the fertilisers necessary to supplement the dung will be somewhat as follows :—

Crop.	*Manures per Acre.*
	Nitrogenous.
Winter and spring corn on poor tilths	1 cwt. Sulphate of Ammonia.
Grass for hay (½ the total area)	or Nitrate of Soda.
	or Nitrate of Lime.
Potatoes	2 cwt. Sulphate of Ammonia.
Mangolds, Swedes, Kohl Rabi, Kales, Maize, etc.	1 cwt. Sulphate of Ammonia and 1 cwt. Nitrate of Soda or of Lime.

	Phosphatic.
Second straw crops in succession	2 cwt. Superphosphate or equivalent Basic Slag.
Potatoes, Roots, Fodder crops ... Meadow land ($\frac{1}{3}$ of the total) ...	4 cwt. Superphosphate or equivalent Basic Slag.
Pasture ($\frac{1}{5}$ of the total) ...	7 cwt. Basic Slag.
	Potassic.
Potatoes	1 cwt. Sulphate of Potash.
Mangolds, Swedes, and Cabbage, etc.	4 cwt. Kainit or equivalent 20 or 30 % Potash Salts.
Second straw crops in succession	$\frac{1}{2}$ cwt. Muriate of Potash or equivalent lower grade Salts.
Meadow land ($\frac{1}{3}$ of total) ...	4 cwt. Kainit or equivalent 20 or 30 % Salts.
	Lime.
$\frac{1}{5}$ of the arable land	1 ton of Ground Limestone, or 10 cwt. of Ground Lime.

Taking the case of a farm, half arable and half grass, managed on a five-course system (roots, barley, seeds, wheat, oats) the yearly cost of the manures required according to the above scheme would be about 13s. per acre over the farm, made up of 19s. per acre on the arable land and 8s. per acre over the grass land. Although the use of fertilisers at some such rate as that outlined is by no means uncommon on farms run at a high level, it is considerably in excess of the average rate of consumption of artificials in this country. This is brought out by expressing its various manures in terms of sulphate of ammonia, superphosphate, and kainit respectively, and calculating the consumption per arable acre per annum. For the farm under discussion only those manures which would be applied to the arable have been taken into consideration; in the case of the figures for Great Britain and Ireland (1922) all the fertilisers used have calculated to the arable land and the results will be somewhat in excess of the actual amounts on account of the manures (chiefly phosphatic) consumed on the grass land. Under these conditions the comparison works out as follows :—

Fertilisers used per acre of Arable Land.

	Nitrogenous: as Sulphate of Ammonia. lb.	*Phosphatic:* as Superphosphate. lb.	*Potassic:* as Kainit. lb.
Farm as above (excluding manures put to grass) ...	63 ...	... 134 ...	... 134
Great Britain and Ireland (total fertilisers used 1922)	19 ...	... 88 ...	... 12

It is seen that the general level of fertiliser treatment on the system outlined is well above the average for arable land in the British Isles: this is particularly the case with regard to the consumption of nitrogen and even more so of potash. It is not, however, excessive when compared with similar figures for some of the Continental countries. The following estimates for 1922 were calculated from data supplied in a recent publication of the International Institute of Agriculture, Rome.*

Fertilisers consumed per acre of Arable Land, 1922.

	Nitrogenous; as Sulphate of Ammonia.	*Phosphatic:* as Superphosphate.	*Potassic:* as Kainit.
	lb.	lb.	lb.
France	10 ...	... 110 ...	... 47
Germany	48 ...	... 102 ...	... 336
Holland	80 ...	... 497 ...	... 680
Farm under discussion ...	63 ...	... 134 ...	... 134

It is interesting to note that the general level of fertilisers consumption per acre in Holland greatly exceeds that of the farm discussed; while Germany exceeds it in potash consumption and approaches it in the use of nitrogen and phosphate. Since the scale of fertiliser treatment above outlined is a generous one for English conditions, it appears that the consumption of artificials could be extended with advantage on many farms in this country, particularly where only small quantities of feeding stuffs are purchased, provided that the additional quantities were used to the best advantage.

Observation of Fertiliser Action.—Although the carrying out of exact experiments is not part of the farmer's business, a good deal can be learnt as to the effectiveness of the manures used if, when dressing a field, a narrow strip is left untreated for comparative purposes. If there is a distinct difference in the crop in favour of the treated area, either in yield, earliness to harvest, stiffness of straw, fullness of plant, or quality of herbage, one may be fairly sure that the use of the manure has been justified, for only large and definite improvements can be thus observed with certainty. If no visible benefit can be seen as a result of the manurial treatment it does not necessarily follow that the fertiliser has been entirely wasted, for apart from a smaller increase in crop, an improvement in quality, feeding value, or bushel weight may have been effected; and, in the case of phosphate and potash manures the unused residues will remain in the soil for the use of subsequent crops. It will

* Production et Consommation des engrais chimiques, 1924.

be understood that since the interpretation of the results even of exact experiments is a matter of some difficulty, too much weight should not be placed on deductions made from observations of the kind outlined; they should, however, give a good general idea of the manurial requirements of the farm under the cropping system actually in operation.

Phosphates for Grass Land.—Although basic slag may be applied to grass land at any convenient time, autumn and early winter are usually chosen for this operation. In pre-war days, when 40 per cent. Bessemer slag was generally obtainable, a dressing of 10 cwt. of basic slag per acre was commonly given and its effects lasted for seven or more years. A heavy dressing of this kind was found to be more satisfactory than a series of light dressings at short intervals. At the present time we have to use basic slags of considerably lower phosphate content than the above, the common grades ranging from 20 to 30 per cent. of phosphate. Hence the equivalent of the previous dressing will be from 20 to 13 cwt. per acre of present-day slags according to the grade. These quantities are more than farmers are willing to apply, but when smaller dressings are given their lasting effects are correspondingly reduced, and the grass should be watched for signs of the need of further treatment. With the change in grade and also in the nature of basic slags—for some of the recent open hearth slags are less soluble and somewhat less effective than slags of the Bessemer type—the question of alternative phosphatic fertilisers for grass land is of importance.

Where the soil is well supplied with chalk and the rainfall is too low to give the less soluble phosphates the best chance of acting, superphosphate may often be used with good results. In regions of high rainfall and on peaty soils certain of the finely ground rock phosphates have proved practically as effective as basic slags for grass land improvement. Of these substances there are two types available :—

(1) North African phosphates, of which Gafsa phosphate is one of the best known. These contain about 60 per cent. of phosphate and a certain amount of chalk.

(2) The harder, richer, somewhat less soluble type from North America and Ocean Island, of which Nauru phosphate containing about 80 per cent. of calcium phosphate is a common representative.

On the whole, experiments show that the first of these types gets into action quicker than the second, and where these sub-

stances have given little result in the first year after application they have frequently shown up well in subsequent years.

Bone manures, either bone meal or steamed bone flour, are popular phosphatic manures for grass land. The former owes some of its value to the fact that it contains about 4½ per cent. of nitrogen in addition to its 45 per cent of phosphate, but on the other hand it is usually coarse in mechanical condition. As a phosphatic fertiliser, steamed bone flour containing 60 per cent. of phosphate, and in an exceedingly fine state of division, is quicker to act. Whatever type of phosphate is decided on, a good dressing, such as will provide about 3 cwt. of phosphate of lime per acre, should be given, for this favours a quick response and postpones the need for further applications.

Potash with Phosphate.—Part of the value of basic slag is attributed to the fact that it contains some basic materials (free lime and other substances which are converted into bicarbonate of lime in the soil) which set free potash from the silicate occurring in many clays. Consequently slagged grass on heavy land benefits from indirect potash treatment as well as from the direct addition of phosphate. The result is the luxuriant growth of clovers which are admittedly responsive to phosphate and potash treatment. It is well known, however, that phosphatic manures sometimes fail to bring about any striking improvement on certain types of grass land. The reason may be either that the soil itself is poor in potash, as in the case of sandy types, or that the replaceable potash of a heavier soil has been exhausted by the application of basic material or salt for many years. In these circumstances a potash dressing in addition to the phosphatic application will usually produce the required result. In cases of doubt it is wise to make a small scale trial on the field in question by crossing the phosphate-treated land with a dressing of kainit and observing the result. Should the need of potash treatment be indicated, the potash is best applied as one of the low-grade salts—such as those containing 12½, 14, 20 or 30 per cent. of potash—the remainder of these fertilisers being largely common salt, which is itself beneficial to grass land. As an outcome of the growing appreciation of the use of potash in conjunction with phosphate on the lighter soils, and in certain circumstances on heavy soils as well, additions have recently been made to the class of phosphate-potash fertilisers of which potassic superphosphate was an early representative. Finely ground mixtures of potash salts with basic slag and with North African phosphate

are now obtainable, containing such proportions of potash and phosphate as would be normally used in practice.

Winter Oats after Wheat.—Inquiries have been received as to what fertiliser treatment would be advisable for winter oats following wheat on land in poor or medium condition. In cases like the above the safest line of procedure is to give a dressing of artificials which will provide nitrogen, phosphate, and potash. The dressing would be divided into two sections, the phosphate and potash mixture being applied in autumn before drilling, the nitrogen being reserved for a top dressing in early spring. Suitable quantities for ordinary circumstances would be: 2 cwt. superphosphate and ½ cwt. muriate of potash per acre in autumn, and 1½ cwt. sulphate of ammonia per acre in spring. The phosphate could, if desired, be applied as equivalent basic slag or steamed bone flour, the potash as potash salts or kainit, the nitrogen as nitrate of soda or of lime, in which case the top dressing could be delayed till somewhat later in the spring than would be advisable with sulphate of ammonia. In the absence of a dryer such as steamed bone flour the condition of fertiliser mixtures does not improve in storage and a good rule is to mix and apply on the same day. The most likely modification of the suggested scheme would be where the soil was clay of a type which only required potash for such crops as mangolds or potatoes, or where a good dressing of dung has been given one or two years before: in such cases the potash dressing could be omitted.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Balanced Ration.—The success of a stockfeeder depends to a considerable extent upon his capacity for constructing a well-balanced ration for any given purpose. What are the guiding principles upon which he works? Under the old rule-of-thumb methods, various mixtures of feeding stuffs were included in rations, and those rations shown to be unsuitable were rejected, so that by the process of elimination the stockfeeder gradually evolved a series of mixtures which he found to be efficient for the purpose he had in view. This system had its disadvantages, since mixtures, and in some cases, individual feeding stuffs, were rejected as useless, when by some

slight adjustment of the ration they could have been shown to be highly efficient.

A case which came to the writer's notice is apposite in illustrating this point. An importer of feeding stuffs wished to ascertain the suitability of liquid egg-yolk as a pig-feeding material, and asked a farmer friend to test it for him, sending him a barrel of egg-yolk for the purpose. The farmer knocked out the end of the barrel, poured the contents into the pig trough, and judging by the avidity with which the pigs consumed the material gave a preliminary favourable judgment. This judgment he reversed in the light of after events, the pigs naturally suffering considerably from the overdose of a highly concentrated nitrogenous and fatty foodstuff. On the strength of his personal experience this farmer condemned a feeding stuff which, rightly used, is quite suitable for pig-feeding.

Similarly, maize has been condemned as a partial substitute for oats in the food for working horses on the ground that its use leads to excessive sweating and loss of condition. The reason for this effect is due to the feeder substituting an equal weight of maize for the oats he is replacing, maize being of a higher calorific value than oats. Had the feeder replaced the oats by four-fifths of its weight in maize, the excessive sweating would not have occurred, and the horse would have kept in condition.

What then, are the considerations to be kept in view in building up a balanced ration? Modern science has shown that to produce a given result the animal must be supplied with a certain amount of protein, a certain amount of energy in the form of fat and starch, and the ration must also satisfy the animal's mineral requirements for mineral salts, and those elusive substances grouped in modern literature under the general term "vitamins." In addition to these basic requirements, the "bulk" of the ration must lie between minimum and maximum limits which vary considerably with the species and age of the animal concerned. The ration also must be neither too constipating in character nor too laxative, and must also be palatable. The bulk of the ration is chiefly affected by the amount of woody fibre present, and is best measured by the amount of dry matter present in the ration. Except in the case of heavy root feeding, the amount of water present in the ration may be ignored, since the animal compensates the variable water content by the extent to which it drinks from the water trough.

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	—	—	12/3	12 5	0 15	11 10	71·6	3/3	1·74
Barley, British Feeding	—	—	13/-	13 0	0 12	12 8	71	3/6	1·87
Barley, Canadian, No. 3 Western	45/9	400	12/10	12 17	0 12	12 5	71	3/5	1·83
„ Karachi	44/9	„	12/6	12 10	0 12	11 18	71	3/4	1·78
„ Russian	44/9	„	12/6	12 10	0 12	11 18	71	3/4	1·78
Oats, English, White	—	—	9/6	9 10	0 13	8 17	59·5	3/-	1·61
„ „ Black and Grey	—	—	9/-	9 0	0 13	8 7	59·5	2/10	1·52
„ Canadian :—									
No. 2 Western	33/9	320	11/10	11 17	0 13	11 4	59·5	3/9	2·01
No. 3 „	32/6	„	11/4	11 7	0 13	10 14	59·5	3/7	1·92
Feed	31/6	„	11/-	11 0	0 13	10 7	59·5	3/6	1·87
„ Argentine	28/-	„	9/10	9 17	0 13	9 4	59·5	3/1	1·65
„ Chilian	26/6	„	9/3	9 5†	0 13	8 12	59·5	2/11	1·56
Maize, Argentine	44/6	480	10/5	10 8	0 13	9 15	81	2/5	1·29
„ Odessa	43/-	—	10/-	10 0†	0 13	9 7	81	2/4	1·25
Beans, Rangoon	—	—	10/10	10 17†	1 11	9 6	67	2/9	1·47
Peas, Japanese	—	—	21/3	21 5†	1 7	19 18	69	5/9	3·08
Rye, Homegrown	—	—	10/5	10 8	0 15	9 13	71·6	2/8	1·43
Millers' Offals :—									
Bran, British	—	—	—	8 2	1 6	6 16	45	3/-	1·61
„ Broad	—	—	—	8 17	1 6	7 11	45	3/4	1·78
Middlings—									
Fine Imported	—	—	—	10 12	1 1	9 11	72	2/8	1·43
Coarse, British	—	—	—	9 12	1 1	8 11	64	2/8	1·43
Pollards, Imported	—	—	—	8 10	1 6	7 4	60	2/5	1·29
Meal, Barley	—	—	—	13 15	0 12	13 3	71	3 8	1·96
„ Maize	—	—	—	12 0	0 13	11 7	81	2/10	1·52
„ „ Germ	—	—	—	11 10	0 18	10 12	85·3	2/6	1·34
„ „ Gluten Feed	—	—	—	10 10	1 6	9 4	75·6	2/5	1·29
„ Locust Bean	—	—	—	10 0	0 9	9 11	71·4	2/8	1·43
„ Bean	—	—	—	13 15	1 11	12 4	67	3/8	1·96
„ Fish	—	—	—	19 10	4 3	15 7	53	5/9	3·08
Linseed	—	—	—	22 10	1 10	21 0	119	3/6	1·87
„ Cake, English 12°/ₒ Oil	—	—	—	14 17	1 17	13 0	74	3/6	1·87
„ „ 10°/ₒ Oil	—	—	—	14 2	1 17	12 5	74	3/4	1·78
„ „ 9°/ₒ Oil	—	—	—	14 0	1 17	12 3	74	3/3	1·74
Soya Bean Cake 6°/ₒ Oil	—	—	—	12 5*	2 12	9 13	69	2/10	1·52
Cottonseed Cake, English 5½°/ₒ Oil	—	—	—	9 10	1 13	7 17	42	3/9	2·01
„ „ Egyptian 5½°/ₒ Oil	—	—	—	9 2†	1.13	7 9	42	3/7	1·92
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 0†	2 12	10 8	71	2/11	1·56
Palm Kernel Cake 6°/ₒ Oil	—	—	—	8 15	1 2	7 13	75	2/-	1·07
„ „ Meal 2°/ₒ Oil	—	—	—	8 0	1 3	6 17	71·3	1/11	1·03
Feeding Treacle	—	—	—	7 15	0 8	7 7	51	2/11	1·56
Brewers' Grains :—									
Dried Ale	—	—	—	8 7	1 3	7 4	49	3/-	1·61
„ Porter	—	—	—	8 0	1 3	6 17	49	2/10	1·52
Wet Ale	—	—	—	1 5	0 9	0 16	15	1/1	0·58
„ Porter	—	—	—	0 19	0 9	0 10	15	-/8	0·36
Malt Culms	—	—	—	7 5	1 13	5 12	43	2/7	1·38

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of August and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar

The success of a ration depends upon the extent to which the feeder has managed to satisfy all the requirements indicated above, and most of the text-books on the feeding of animals contain the essential data required for achieving this result. In building up a ration, the feeder will generally be able to satisfy the requirements for energy and bulk from the home-grown feeding stuffs, but it will be generally necessary to bring in protein—rich cakes and meals to satisfy the protein requirements. It is particularly in this direction that purchased feeding stuffs are of value to the farmer.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·25	2 4	71·6	8 7	0 15	9 2
Oats	1·25	2 4	59·5	6 19	0 13	7 12
Barley	1·25	2 4	71·0	8 6	0 12	8 18
Potatoes	1·25	2 4	18·0	2 2	0 3	2 5
Swedes	1·25	2 4	7·0	0 16	0 2	0 18
Mangolds	1·25	2 4	6·0	0 14	0 3	0 17
Good Meadow Hay	1·61	3 0	31·0	4 13	0 13	5 6
Good Oat Straw	1·61	3 0	17·0	2 11	0 6	2 17
Good Clover Hay	1·61	3 0	32·0	4 16	1 0	5 16
Vetch and Oat Silage	1·43	2 8	14·0	1 17	0 7	2 4

NOTE.—In arriving at the figures for "value per ton on farm" in the September issue of the *Journal* (p. 589), the "manurial value per ton" was *deducted* from the "food value per ton" instead of being *added*, so that the figures in the last column of the above table were incorrect.

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending September 10th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	13.17	13.12	13.10	17. 5
" " Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	12.19*	12.19*	12.19*	12.19*	(N)12. 6
" " " neutral (N. 21.1 per cent.)	14. 2*	14. 2*	14. 2*	14. 2*	(N)13. 4
Kainit (Pot. 12¼ per cent.)	...	..	...	2. 2	3. 5
French Kainit (Pot. 14 per cent.)	2.10	2. 5	2. 5	2. 5	3. 3
" " (Pot. 20 per cent.)	...	2.10	...	2.10	2. 6
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.)	...	...	2.10	2. 7	2. 4
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	6.15	6.10	6.10	2. 7
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	11.10	11. 0	4. 7
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	2.12§	1. 9
" " (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
" " (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
" " (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 5	1.10
" (S.P. 30 per cent.) ...	...	3. 0	3. 8	2.19	1.11
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.10	8.10	8. 2	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	7. 2†	6. 0	6. 2†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
" " (N. 9, T.P. 10 per cent.) ...	...	...	...	13. 0	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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Damage by Moles to River Embankments.

As the result of inspections in connection more especially with the Ministry's Drainage schemes for the relief of unemployment, the Ministry's attention is constantly being directed by its Inspectors to the serious damage that is being done to river embankments by moles.

The Ministry has therefore addressed a circular letter to the clerks of all drainage authorities urging upon them the vital importance, from the point of view of embankment maintenance, of unremitting energy in combating this menace.

The first indication of damage by moles is generally the increased amount of pumping which is required in areas which

depend on pumping for the discharge of their water, and the consequent heavy additional expenditure on fuel, leading, in some cases, to proposals to increase the capacity of the pumping plant. Examination of some of these cases has shown that the trouble arises from the fact that the embankments are so honeycombed by moles that they not only leak, but cannot be relied on to resist even the ordinary pressure of winter waters.

Some of the most efficient of the Eastern Counties' drainage authorities find it necessary to spend, annually, at least £2 per mile of embankment on mole-catching alone, and the condition of the embankments of these authorities, as compared with those of authorities which pay less attention to the matter, goes to prove that the policy is not only justified, but essential.

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Kent Clean Milk Competition.

THE first Clean Milk Competition to be held in Kent was organised in 1923 by the Kent Local Education Authority in conjunction with the Kent Milk Recording Society and attracted 53 entries. As the results were so good, and widespread interest in this movement had been created, the Kent Milk Recording Society published a full report on the Competition in the form of a handbook entitled "Clean Milk in Kent." The handbook included prefatory letters by the Minister of Agriculture (Sir Robert Sanders) and Sir A. D. Hall, K.C.B., LL.D., F.R.S., and 20,000 copies were printed and distributed broadcast.

In accordance with the general desire expressed within the county a second clean milk competition was held this year under the same organisation. 46 farmers entered this competition, the scheme of which was mainly in accordance with that recommended by the Ministry; the relative efficiency of competitors was recorded in the form of marks based on conditions on the farm, as judged by inspection, and examination of the milk produced. The competition extended from the 1st January, 1924, to the 1st April, 1924, during which period each competitor submitted a sample of milk fortnightly; in addition at least one surprise visit of inspection was paid to each farm while milking was in progress and a sample taken. All samples of milk were examined at Wye College for bacterial count, presence or absence of *bacillus coli*, keeping qualities, and butter fat. These examinations showed that whilst only 4 of the 46 competitors were producers under Ministry of Health licence of either Certified or

Grade A milk, of the samples submitted by competitors 87 per cent. reached Grade A standards and 67 per cent. Certified standards, and of the surprise samples the percentages were 87 and 74 respectively. Further, the samples kept perfectly sweet and untainted in an incubator at 60° F. for an average of 3 days 1 hour as compared with an average of 2 days 9½ hours in the first competition.

To the competitor, an interesting and useful feature of the competition has been the issue of interim reports. These reports include general information and results of each series of samples, together with observations as to the work of each competitor (shown under coded numbers, no names being mentioned) and from them the competitor can ascertain where improvements can be made. No less than 36 of the 46 competitors obtained over two-thirds of the total marks possible and thus qualified for diplomas, as compared with 14 out of 53 in the 1923 competition. Further, there were 28 farmers in the 1924 competition who had competed in the previous one, and with one exception they obtained increased marks; that their progress was sure is demonstrated by the average increase in their marks, viz., 27 per cent.

In the course of his final report the inspecting judge stated that the competition had again proved that elaborate and expensive buildings are not necessary and that while modern buildings certainly make the work much easier, provided there is ample light, good ventilation and sound flooring, the buildings take a secondary place in the production of clean milk. He added that at the beginning of the 1923 competition he found that the conditions under which the milk was produced were often exceedingly poor, but great improvements were soon made: in the 1924 competition it was at times difficult to realise that he was inspecting the same farm as in the previous year.

The winner of the Challenge Cup (Mr. C. Baker) is a milk producer and retailer, who keeps 26 cows and occupies approximately 100 acres of land. His cow sheds have been erected with his own labour, and are chiefly of wood and corrugated iron and have no expensive fittings. His success further demonstrates that the production of clean milk is primarily a question of intelligent interest and care on the part of the owner of the herd and his employees.

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Berkshire Clean Milk Competition, 1924.

FOLLOWING on the very successful series of clean milk demonstrations organised in Berkshire, a clean milk competition was held this year. The competition was novel inasmuch as it was open to herdsmen only, but it was assisted by the Ministry in the expectation that it would lead to a more comprehensive scheme at a later date. Judging was based on inspection on the farm and the bacteriological determination of samples of milk taken at regular intervals, all samples being examined at the National Institute for Research in Dairying, Reading. Seven entries were obtained and the competition extended for a period of twelve weeks from 4th February, 1924. No samples were taken nor inspections made until a month had elapsed, and during this preliminary period the County Dairy Instructress was free to visit and advise any competitors who desired her help. All farms were inspected during the first and last fortnights of the active competition period, in order that the judges might ascertain what improvements had been made. It is notable, however, that in their final report the judges said that in the interval between these two inspections only slight changes in the conditions on the farms were noticeable, probably because improvements had been made in the preliminary period.

The judges, whilst expressing the opinion that the competition had done valuable work and should form a good basis for extended work next year, added that the points in which there was most need for improvement were (1) Method of milking; (2) methods of washing and sterilising; (3) cleanliness of milkers' hands and frequent washing of same; (4) handling of milk previous to cooling; and (5) frequent lime-washing of buildings.

Of the seven competitors five obtained over two-thirds of the total marks possible. Three money prizes and six certificates were awarded.

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Research in Glasshouse Crops.

THE Nursery and Market Garden Industries' Development Society, Ltd., in the Ninth Annual Report of the working during 1923 of the Experimental and Research Station at Cheshunt, is able to record satisfactory progress. Members of the glasshouse industry, in all parts of the country, have shown increased interest in the work of the experimental station, and have availed themselves more and

more of its advisory and research facilities. Subscriptions from members during 1923 amounted to £233 more than in 1922. Five new glasshouses have been erected, of which four are of the modern "aeroplane" type, built in block formation; the fifth, which has six chambers, is designed for special experiments.

Manuring.—The manurial experiments which were started in 1915 to determine the most economical dressings for the district have been revised and a new series begun. These new experiments, which will be continued for several years, are designed to determine the right proportions of nitrogen, phosphates and potash for tomato culture.

In 1923 the results appear to show some correlation between the percentage of blotchy fruit and the kind and amount of chemical in the fertiliser, *e.g.*, by adding 5 per cent. of nitrogen in the fertiliser for a nitrogen-starved soil the amount of blotchy fruit was reduced from 10.23 per cent. to 2 per cent. Additions of potash also reduced the amount of blotch, and it was concluded that a deficiency of both nitrogen and potash in the soil increases the quantity of blotchy fruit—which ripens irregularly and sells at a low price. Unmanured plots and those from which nitrogen, phosphates and potash have been continuously omitted, gave much lower yields than plots manured with a single dressing of complete artificials—though a double dressing of complete artificials proved excessive and depressed the yield.

A plant, such as the tomato, can only continue to give large crops if the soil in which it is grown is supplied with plant food in adequate but not excessive quantities of well-balanced fertilisers, and these experiments are likely to give growers a more exact knowledge of the plant's requirements than has hitherto been possible.

Carbon Dioxide Experiments.—The station has continued the carbon dioxide experiments to ascertain whether increased crops could be obtained by charging the atmosphere in which tomato plants were grown with supplies of carbon dioxide, as has been claimed to have been accomplished by a German firm. Whilst the experiments have as yet produced no very definite crop increases, it was noticed that more root diseases were present in the houses receiving supplies of carbon dioxide.

Soil Sterilisation.—A determination of the best method of sterilising soil is of importance to all growers, and particularly for glasshouse work. The method best suited to the commercial

grower is determined by a number of factors, of which efficiency, cost and ease of application are the most important. The Report shows the results which have been obtained by treating soil with steam, carbolic acid, formaldehyde, hot water, chlordinitrobenzene, dichlorcresol, and emulsified heavy oils. Notes are given on page 65 of the Report as to the exact method of application of the newer chemicals.

Diseases of Glasshouse Crops.—Dr. Bewley has continued his mycological investigations of glasshouse crops, especially as regards Mosaic disease of the tomato and cucumber, and in the Report gives a short account of a root disease of the tomato due to *Colletotrichum tabificum.* This disease destroys the root tissues, in which minute sclerotial bodies are then developed. The disease has been isolated in culture media and found to be capable of infecting roots of both the tomato and the potato.

Entomological Investigations.—These have been continued by Mr. Speyer, and a most interesting account is given of experiments to keep down red spider by using volatile chemical substances such as ammonia, pyridine, carbon disulphide, naphthalene, etc. The results from the experiments were not encouraging, and the experimenters came to the conclusions, regarding fumigation against red spider :—(1) That the action of gases and volatile liquids is ineffective owing to their rapid escape from the atmosphere in glasshouses and owing to the difficulty of keeping up a comparatively high concentration of the vapours sufficiently long to kill the spider; (2) that naphthalene, when heated, is the type of fumigant suited to the purpose, provided that, within broad limits, the amount of its vapour in the atmosphere can be controlled so that no injury is caused to the plant.

Woodlice.—Red beets and mangolds used as traps proved a satisfactory control. By cutting them in half, placing the cut surface on the ground between the cucumber plants (one half to every four plants) and collecting the woodlice in a pail every morning, a control was maintained up to August. Woodlice were also kept under in tomato houses by the use of poison baits, of which a solution containing oatmeal 50 parts, potassium bichromate 1 part, glucose 2 parts, and water 30 parts proved the most effective.

Mr. Owen Owen took up his duties as chemist at the station in January, 1923, and gives in the Report an account of the analyses of the soil in the nursery plantations.

The experiments are of importance to all growers of glasshouse produce, who should certainly read the Report. It is

also of much interest to others concerned with food production. It is a report showing progress in research at a time when the industry is passing through a critical time, and when its members are susceptible to new ideas and methods such as are made manifest only by carefully planned research experiments.

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Co-operative Bacon Factories.

FOLLOWING upon the success of certain bacon factories in the south of England, a proposal is on foot to form a Border Farmers' Bacon Factory, Ltd., in the Border counties of England and Scotland. The factory itself, which is to be situated at Carlisle, will be run by the company as a co-operative society and will later be registered under the Industrial and Provident Societies Acts. The factory will carry on bacon curing and will deal also with pig by-products.

The qualification for membership of the society will be the holding of not less than one £1 share nor more than 200 £1 shares in the company. The whole of the net profits, after payment of interest not exceeding 5 per cent. per annum to the shareholders, will be divided among the contracting members who send pigs to the factory. It is estimated that with a capital of £25,000 an average supply of 500 pigs weekly can be dealt with. If further capital is found to be required the committee of management will probably issue loan stock in the name of the society, or apply for a loan from the Ministry of Agriculture or the Board of Agriculture for Scotland under the scheme of Government assistance for the development of forms of co-operation devoted to the preparation and marketing of agricultural produce.

This is an interesting development in co-operation in the north of England, and it is confidently expected that it will meet with success. The one thing needful is that the members should support the society by supplying pigs of the most suitable type for bacon purposes, as to which the experts at the factory will be ready to advise producers.

Among the reasons why Border farmers should support the undertaking the following are given:—

(1) The movement is promoted purely in the interests of pig-producers, and is to be financed and managed by them;

(2) It is a necessary part of the scheme that as high prices shall be given for pig products as is possible, consistently with safe and efficient business methods;

(3) The operation of all such factories has a steadying influence on pig prices generally;

(4) A steady remunerative outlet for bacon-pigs helps the breeder of commercial and of pedigree pigs as well as the feeder;

(5) The careful and skilful feeder gets his due reward, as high quality means high prices;

(6) The producers are saved the time, commission, and expense of attending sales at an auction mart.

These advantages may all quite reasonably be expected to result from the establishment of a co-operative bacon-factory, and farmers in all parts of the country are reminded that the Government is prepared to assist the formation of such societies by making a loan of capital.

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The International Seed Testing Association.

AT the International Seed Testing Congress recently held at Cambridge, Mr. K. Dorph-Petersen presented a report on the work of the European Seed Testing Association, which was formed at the International Seed Testing Congress at Copenhagen in 1921. A brief summary of this report may be of interest to readers of this *Journal*.

A Committee, consisting of Mr. Dorph-Petersen, Mr. F. F. Bruijning, Wageningen, and Dr. Volkart, Zurich, was elected to direct the Association. Owing to the death of Mr. Bruijning, Mr. Dorph-Petersen and Dr. Volkart have carried on together. Dr. Volkart conducted the work in connection with the determination of origin; Mr. Dorph-Petersen carried out the work of distributing samples for comparative tests, the tabulation of the results of these tests, and all correspondence arising in this connection, and in addition he corresponded with all institutions which were, or intended to be, members of the Association.

The comparative samples which had been sent out up to the date of the Congress comprised three sets. The first set of 25 samples was sent out before the 1921 Congress, and these samples were tested by, and reports received from, 24 stations. The second series, consisting of 24 samples, was sent out in March, 1922, and reports on these samples were received from 41 stations. The third series, consisting of 21 samples, was sent out in November, 1923, 54 sets were distributed, and up to the date of the Congress reports had been received from 47 stations. Full details of the results of the first series appeared in the

Report of the Conference held at Copenhagen in 1921, and details of the other series were given by Mr. Dorph-Petersen and will appear in the Report of the Cambridge Congress.

A Sub-Committee was also appointed at Copenhagen to investigate the latitude of the presence of Dodder. Dr. A. v. Degen, Budapest, was Chairman of this Committee, and he submitted a Report to the Cambridge Congress. Mr. Dorph-Petersen also reported that he and Dr. Volkart had met and discussed the Statutes desirable for the European Seed Testing Association, and had drawn up a paper on this matter. These proposals were subsequently discussed at a meeting of the Cambridge Congress, and it was decided to set up a Committee to consider a draft Constitution.

At a later stage of the Congress the draft Constitution prepared by this Committee was considered and approved. The Constitution provides that the Association shall be named "The International Seed Testing Association," and that it shall be a union of official seed testing stations, with legal domicile at the residence of its President. The purpose of the Association is the advancement of all questions connected with the testing and judgment of seeds, which it will seek to attain by:—

(*a*) Comparative tests and other researches directed to achieving more correct and uniform results than hitherto obtained.

(*b*) The formulation of uniform methods and uniform treatment in the analysis of seeds in international trade.

(*c*) The organisation of International Congresses attended by representatives of official seed testing stations for the purpose of mutual deliberation and information, the publication of treatises and reports on seed testing, and mutual assistance in the training of technical officers.

Membership is open to official stations dealing with seed investigations directly controlled by Governments; similar stations managed by Institutes or Corporations, and effectively controlled by Governments; and Associations of official seed analysts. The income of the Association is derived from annual contributions from its members, the amount of which is to be approved at each General Assembly, and from extraordinary revenues. The amount of these contributions will be so fixed that they are sufficient to cover the cost: (1) of the publications of the Association, (2) of comparative tests and other research work, and (3) of stationery and clerical assistance.

A Congress and General Assembly will be summoned approximately every three years, when the Executive Committee and Officers will be elected. The General Assembly will also appoint such further Committees as may be necessary for the better

ordering of the finance, research, publications, etc.; decide on the place and date of future Congresses; and approve the amount of the contributions.

Other clauses of the Constitution set out particulars as to the despatch of business; the duties and powers of the President and the Vice-President; the voting power of delegates at General Assemblies and Congresses; the withdrawal of members; and the dissolution of the Association. The Constitution also lays down that the Association will, in respect of publications, and in such other ways as the Executive Committee may find convenient, work in co-operation with the International Agricultural Institute at Rome.

After the Constitution had been approved, the Congress proceeded to appoint an Executive Committee, with Mr. Dorph-Petersen as its President. Committees were also elected to deal with the following matters:—

Research for countries with Temperate Climate;
Research for countries with Warm Climate;
Provenance determinations;
Hard Seeds and Broken Seedlings;
Moisture Content and Drying;
Investigations of Genuineness of Variety and of Plant Diseases;
Dodder;
Beet;
Publications and Registration.

Arrangements have been made for the International Agricultural Institute to publish articles and papers dealing with seed testing.

It may be added that a report of the International Seed Testing Congress which was held at Cambridge in July last (a note as to which appeared in this *Journal* in August, p. 403) is in preparation, and will be placed on sale in the near future by His Majesty's Stationery Office.

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National Rat Week, 1924.

THE week commencing Monday, 3rd November, 1924, has been fixed by the Ministry as "Rat Week," when it is hoped that all Local Authorities responsible for the administration of the Rats and Mice (Destruction) Act, 1919, will endeavour to secure concerted action throughout their respective areas with a view to the destruction of rats and mice.

It is suggested that preparations for this special effort be made at once by the officers responsible for rat destruction, and that Authorities will think it worth while to take special measures

during "Rat Week" to concentrate public attention on the subject. It is hoped that all agriculturists and others interested in rat destruction will co-operate in securing the greatest possible destruction of these vermin.

An effort of this kind made during one week in the year cannot, of course, be effective in keeping down rats and mice. This can only be done by *systematic and continuous action.* Nevertheless, "Rat Week" may be productive of good results, not only by ensuring the destruction of large numbers of the rodents, but also by calling public attention to the ravages caused by them, and by affording an opportunity of reminding the public that it is the duty of all occupiers of premises infested with rats and mice to destroy these pests, and that where they fail to do so voluntarily the Local Authority may put into operation their powers under the Act of Parliament.

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Rat Exhibit at Wembley.

A RECENT addition to the exhibits of the Ministry in the Government Pavilion at Wembley deals with rat destruction. In a glass case are shown the species of rats, mice, and voles common to this country, together with some agencies used in their suppression. One group of toxic agents shows red squill in its various forms. These are the "safest" poisons in general use. Baits incorporating barium carbonate are also shown, as well as other mineral and vegetable poisons. Gassing machines, traps, deterrents and deodorisers in many forms are also displayed.

The suppression of rats and mice is not a matter that mainly concerns this country but is one of world-wide importance, and attention has often been directed in this *Journal* to the need for the destruction of these very harmful rodents, both in town and country. The Ministry's rat exhibit at Wembley should be of more than local interest and value.

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Lectures on the Rothamsted Experiments.

DURING the coming winter Mr. H. V. Garner, B.A., the Guide Demonstrator of the Rothamsted Experimental Station, will be able to give a few lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Agricultural Societies, etc., on the Rothamsted experiments in regard to:—(1) Manuring of Root Crops and Potatoes, (2) Manuring of Cereals, (3) Manuring of Grass Land, (4) Manuring of the

Rotation, (5) The Management of Farmyard Manure, (6) Chalking and Liming. For Students' Societies and similar bodies lectures can be arranged dealing with :—(7) The Field Work at Rothamsted, (8) Investigations in the Rothamsted Laboratories, (9) The carrying out of Agricultural Experiments.

Any such associations wishing to avail themselves of Mr. Garner's services are invited to communicate as soon as possible with The Secretary, Rothamsted Experimental Station, Harpenden, Herts, indicating the subject or subjects which would be of most interest to their members and dates that would be convenient to them. Only one subject can be dealt with in a single lecture. No fee will be charged for Mr. Garner's services, but any association engaging him will be expected to defray his travelling expenses and to make such arrangements for the lecture as may be necessary.

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Foot-and-Mouth Disease.—There is a very great improvement in the position, the number of outbreaks for the four weeks ended 14th September being 18 in all, which was the weekly average during the preceding four weeks.

In the week ended 24th August, there were outbreaks in Kent (1); Northants (1); Notts (2); Oxford (2); and Wilts (1); and in the following week, in Derby (1); Kent (1); Kesteven (Lincs) (1); Oxford (1); and Wilts (2); in the week ended 7th September, in Kesteven (1); and Northants (1); and in the following week Essex (1); Kesteven (1); and Wilts (1).

There was only one new centre of disease, at Loughton, Essex, on 8th September. Extensions of the existing infected areas in Notts and Northants had also to be made

The number of outbreaks from 27th August, 1923, to 14th September, 1924, is 3,289, and the numbers of stock slaughtered are cattle, 110,071, sheep, 52,925, pigs 49,884 and goats, 129.

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Agricultural Scholarships.—The Ministry and the Board of Agriculture for Scotland invite applications for a limited number of agricultural scholarships, which are open to students who propose to take up posts as agricultural organisers, teachers or lecturers in agriculture, etc. Candidates should be graduates of a University, but exceptional candidates otherwise qualified, who have not had an opportunity of graduating, will be regarded as eligible.

Scholarships are tenable for a period of two years and are intended to give students an opportunity of broadening their knowledge of agriculture both at home and abroad. The value of the scholarships will vary according to the scholars' means, and to the cost of living prevailing in the country visited, but in no case will the value of a scholarship exceed £200 per annum. In addition, laboratory fees and travelling expenses incurred for the purposes of the scholarship will be defrayed.

Forms of application and all other particulars may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall

Place, London, S.W.1, in the case of English and Welsh students, and from the Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, in the case of Scottish students. The latest date for receiving applications is 31st October, 1924.

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Leaflets issued by the Ministry.—Since the date of the list given on page 396 of the July issue of the *Journal*, the following leaflets have been issued:—

New—	No. 17.	Watercress and its Cultivation.
	,, 47.	The Cultivation of Cherries.
Revised—	,, 166.	Some Common Thistles.
	,, 334.	How to Increase Colonies of Bees.
Amended—	,, 170.	The Use of Lime in Agriculture.
	,, 193.	Dry Rot of Potatoes.

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REPLIES TO CORRESPONDENTS.

The Effect of Boron Compounds on Plant Life.—M. S. refers to page 422 of the August issue of this *Journal* and asks for further information.

Reply: The following memorandum, supplied by Dr. W. E. Brenchley, Botanist of the Rothamsted Experimental Station, was sent:—

The experiment which was illustrated at the Royal Show at Leicester, and which is also illustrated at the British Empire Exhibition, was designed to gain further information on the general question of the influence of boron compounds (borax and boric acid) on plant life. By means of growing plants in pure water to which various nutrient substances have been added it has been shown at Rothamsted that very minute quantities of boron compounds are essential for the proper development of some plants. In its absence broad beans die from the growing points without producing flowers, and scarlet runners, soy beans and various species of clover seem equally dependent upon it. The quantity required is so small that one part of boric acid, or even less, to 2,500,000 parts of water is sufficient. Most soils, as it happens, contain sufficient boron to supply the needs of the plant, so this characteristic type of dying off is not seen in soil cultivation.

On the other hand boron compounds in excess are distinctly poisonous, and plants grown in water are injured by 1 part of boric acid in 5,000 or less parts of water. During recent years much damage has been caused to crops in America by the use of potash fertilisers containing borax as an impurity. As yet we have very little information as to whether boron, applied as borax or boric acid, improves the growth of plants in the field, if it is utilised in sufficiently small quantities, and it would be of great value if farmers and gardeners would put the matter to the test. The action of boron compounds might vary according to the soil and climatic conditions. It is most important to remember that owing to the poisonous action of boric acid or boron when applied in excess, very small dressings should be used, 10 lb. an acre apparently being safe for most plants. This may be put on either before the seeds are sown or at any time during the life of the plant, the earlier the better. The method of application would depend upon circumstances. It might be practicable to mix the requisite amount of borax or boric acid very thoroughly with ashes or

with any other fertilisers that are being applied for any crop. Application by means of solution is hardly practicable on a large scale, and, besides, boric acid does not dissolve very easily in cold water, though very readily in hot water.

For the sake of comparison part of each crop or a corresponding plant should be left untreated in each case.

Sawfly on Roses.—Mrs. R. B. sent specimens of damaged rose leaves for opinion and advice.

Reply: The cause of the damage is due to the larvæ of a sawfly (*Blennocampa pusilla*). If the leaves are uncurled and carefully examined, the minute grubs—which are still in a very young stage—will be found to be present.

It is very difficult to control these pests on account of the curling of the leaves, which becomes more severe as the caterpillars grow. A nicotine wash consisting of nicotine 1 oz., soft soap ½ lb., water 10 gallons, will destroy all the larvae, but it is essential that the wash should reach them. Where feasible, the shoots of the roses should be bent over and dipped in the mixture in order that all portions of them should be reached. In any event careful attention to the bushes, ensuring that all portions of the leaves are wetted with the insecticide, will effect a cure.

Capsid Bugs on Currants.—J. T. sent damaged specimens of currant.

Reply: The currant specimens show that the plantation is very badly attacked by Capsid Bugs. A leaflet is enclosed which deals with this pest, which also does damage to apples. The measures described in the leaflet apply equally to the attack on currants, and if you spray with nicotine and soap very thoroughly you should have no difficulty in controlling the insect in future.

Gooseberry Sawfly.—In July, A. E. sent caterpillars for identification and advice.

Reply: The reply sent was that the caterpillars were those of the Gooseberry Sawfly, which is dealt with in one of the Ministry's leaflets, suggestions for control being given.

1. If the number of goosebery bushes involved is not large, the pest would be best dealt with by hand so as to avoid any difficulty with regard to chemicals on the fruit.

2. It is certainly a check on any plant severely to deprive it of foliage.

3. The caterpillars sent were not all of one brood. Some of them were pupating—that is, going to the ground to form a cocoon before attaining the adult stage. Therefore, if treatment was delayed a still larger number would have pupated to form sawflies for further infestation. The sooner the caterpillars are dealt with, therefore, the better.

4. Destruction of the caterpillars this year will make infestation next year less probable; also, if the first small caterpillars next year are dealt with when first seen—which is not difficult as they feed gregariously—there would be less danger of infestation by later broods. Spraying the bushes in the autumn and winter would have no effect on this pest, as the pupæ would be in the soil during this season.

Caterpillars Tunnelling Potato Stems.—In reply to the receipt of a photograph from A. L. H., it was stated that the photo gave

the impression that the larvæ tunnelling the potato stems were those of the Rosy Rustic Moth (*Hydraecia micacea*).

The best control measure is to remove by hand all such potato tops as are seen to be attacked. The destruction of these tops with the larvæ inside will prevent the pupation of the latter and so decrease the pest for the following year. The pest migrates to the potatoes from weeds, such as burdock, growing in the proximity of the potato crop; if possible, the removal of such sources of infection is a good preventive.

Wasps. — J. W. H. inquired as to the beneficial character of wasps.

Reply: Opinions vary considerably as to whether wasps should be considered as beneficial insects or not. They undoubtedly destroy a large number of other insects, both pests and those that are beneficial. It is the opinion of this Department that, considering the damage which is done to fruit by wasps, and that beneficial insects as well as others are included in their diet, they do more harm than good and the balance is against them.

Destroying a queen wasp is equivalent to destroying a nest, but against this many people hold the opinion, not without reason, that neither a queen nor a community of wasps should be destroyed until just prior to the ripening of the fruit as in the meantime a large number of injurious insects are destroyed.

A publication on wasps, including illustrations, will shortly be issued by the Ministry.

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NOTICES OF BOOKS.

Guide to Current Official Statistics.—(Vol. 2, 1923, pp. 306, H.M. Stationery Office. Price 1s. net, post free 1s. 4½d.) This is the second issue of an annual survey of current official statistics prepared by the Permanent Consultative Committee on Official Statistics. Its aim is to enable persons to ascertain readily what official publications containing statistics on a particular subject have been published during the year, and to advise as to the degree and mode of analysis of the statistics given in the different publications.

The Subject Index gives a list of the publications issued by the various Departments, grouped under subjects such as Agriculture, Education, etc., and a system of cross-references enables the whole of the available information on a subject to be readily traced.

This book is invaluable to all those whose work involves the consultation or use of official statistics.

The Chemistry of Crop Production.—(T. B. Wood, C.B.E., M.A., F.I.C., F.R.S., London: University Tutorial Press, 2nd edition, 1924. Price 4s. 6d.) The first edition of this book was reviewed in the *Journal*, February, 1921, p. 1083. The only difference between the first and second editions is that in the latter the examples are based on prices current in 1924.

Farm Engineering: Vol. I., Farm Mechanics. — (Byron Burnett Robb, M.S.A., and Frederick Gardner Behrends, B.S. London: Chapman and Hall, Ltd. Price 12s. 6d.) This is the first volume of a series of books dealing with "farm engineering," as it is known in the United States of America, where it has a much wider meaning than in this country. The series is being written by two American Professors who have had a wide experience of agricultural conditions in the United States.

The volume deals at length with such diversified subjects as harness repairs, knots, hitches and splices, belts, pulleys and shafting, soldering, painting, levelling, farm drainage, concrete work, water supply and sewage disposal. The instructions are eminently practical and fully illustrated, so that even the novice in agricultural engineering is able to follow them. While it contains a good deal of information which an English farmer seldom needs, the book should be a useful addition to a farmer's bookshelf, particularly in out-of-the-way places.

Rothamsted Memoirs, Volume XI.—(Royal Octavo. Half Calf. pp. 908. Price 33s. 6d., inland post free.) Volume XI of the "Rothamsted Memoirs" is now ready for distribution and can be obtained on application to The Secretary, Rothamsted Experimental Station, Harpenden.

This volume includes 51 Memoirs, covering the period from 1920 to 1922. The edition is strictly limited.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

British Sulphate of Ammonia Federation, Ltd.—Sulphate of Ammonia: Its Uses in Agriculture in Europe and the Tropics, by *T. H. J. Carroll.* (68 pp.) London, 1924. [63.1671.]

Holmes, H. R. J.—A Short System of Farm Costing. (107 pp.) Oxford: University Press, 1924, 6s. 6d. net. [657.]

Currier, E. L., Lennes, N. J., and *Merrill, A. S.*—Farm Accounting. (295 pp.) New York and London: Macmillan, 1924, 7s. net. [657.]

Field Crops.

Wood, T. B.—The Chemistry of Crop Production. Second Edition. (193 pp.) London: University Tutorial Press, 1924, 4s. 6d. [54; 63.11; 63.16.]

Horticulture and Fruit Growing.

"*The Fruit Grower*" *Lea Valley Correspondent.*—Commercial Cucumber Culture. (46 pp.) London: Ernest Benn, Ltd., 1924, 2s. 6d. [63.513.]

Morton, J. W.—Commercial Strawberry Culture. (48 pp.) London: Ernest Benn, Ltd., 1924, 2s. 6d. [63.41(c).]

Maynard, H. M.—Marketing Northwestern Apples. (197 pp.) New York: Ronald Press Co., 1923, \$2.50. [63.41(73); 63.41-198.]

Oregon Agricultural Experiment Station.—Bulletin 206:—Studies Relating to the Harvesting and Storage of Apples and Pears. (32 pp.) Corvallis, 1924. [63.41-198.]

Cornell Agricultural Experiment Station.—Bulletin 415:—Results of some Experiments in Pruning Fruit Trees. (75 pp.) Ithaca, New York, 1923. [63.41-195.]

Dairying.

U.S. Department of Agriculture.—Department Bulletin 1272:—Values of Various New Feeds for Dairy Cows. [Fishmeal, Peanut feed, Potato meal, Velvet-Bean meal, Sweet-Potato meal, Potato silage, Apple-pectin pulp, Hydrolyzed sawdust, Cane molasses.] (16 pp.) Washington, 1924. [63.711; 63.60432.]

Poultry.

Capper, A. H.—One Man Poultry Farming. (50 pp.) Scientific Poultry Breeders Association, Rudgwick, Sussex, 1924, 1s. net. [63.651.]

Toovey, T. W.—Commercial Poultry Farming: a description of the evolutionary progress of the King's Langley Poultry Farm and its Management. Third edition containing a supplementary chapter describing alterations in methods since publication of second edition, 1922. (148 pp.) London: Crosby, Lockwood & Son, 1924, 6s. [63.65.]

Powell-Owen, W.—The Complete Poultry Book. (345 pp. and 32 pl.) London: Cassell & Co., 1924, 10s. 6d. net. [63.65.]

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE,
By Metchim & Son, Princes Street, Westminster, S.W.1.

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NOTES FOR THE MONTH.

The Minister's Wireless Message to Farmers.

IN inaugurating the new series of fortnightly broadcast talks to farmers on 3rd October, Mr. Noel Buxton, M.P., said that he regarded wireless as an important asset to the movement for brightening country life and inducing people to remain on the land, but apart from this, he believed it could be of use to the farmer in his business. He emphasised the point that the Ministry did not pretend to dictate to the farmer about his business; its aim is to assist him by supplying information, advice and practical help. Apart from the Ministry itself, machinery exists in each county, through County Agricultural Organisers, for advising the farmer on the peculiar problems of his farm. He appealed to farmers to make more use of these facilities for assisting them in solving their difficulties. They could also, by wireless, obtain information on the results of the work at various research stations, and on new methods of husbandry both in this country and abroad. Never before had so much assistance been given by the State to promote agricultural education and research.

If the farmer was to succeed in his business, it was very essential that he should be not only an expert producer but that he should market his produce to the best advantage. He recommended all farmers to "listen in" for the notes on prices which would be broadcast each fortnight, and also to obtain every Friday the Ministry's *Agricultural Market Report*.

One of the most promising developments in agriculture throughout the world was the progress made in co-operation during the last few years. At the recent Co-operative Congress at Wembley, all the spokesmen of the Dominions emphasised the importance of co-operation in marketing farm produce, and

described how it led to the prosperity of their farmers. He was glad to be able to state that British farmers to-day were alive to the need for such combination in this country. The National Farmers' Union was taking steps to prepare the way. The British Government, supported on this question by all Parties, was eager to give practical assistance, and had initiated a scheme for making loans to co-operative societies and furnishing credit facilities in other ways. He had recently visited Wales and was much impressed with the advanced stage of co-operation there.

On behalf of the farmer and farm worker he appealed to the general public for their sympathy and interest. Agriculture was the world's basic industry. The producers of food, who usually work in isolated and remote areas, had a special claim on the community. A flourishing countryside was vital to the national health, and if we were to become an A.1 population, more people should work on the land. Unless a healthy proportion was maintained between the people on the land and those in the towns, the nation would become top-heavy, and its future be gravely menaced.

He impressed upon his hearers the advantages of consuming home-produced food. In his own household, he said, only bread made entirely from home-grown wheat was used. There were still some people who did not know of the new wheat called "Yeoman," which produced an excellent crop on English soil, and made very good flour. An increasing use of home produce would not only benefit the consumer, but be of great service to the British farmer, and thus doubly promote the national welfare. In conclusion, he said that the Ministry of Agriculture would be glad to answer inquiries arising out of the broadcast talk or to assist farmers and others in any way it could. His department was entirely out to help, and he asked agriculturists not to hesitate to make use of it. He would emphasise that the aim of the Ministry was to be the farmer's friend.

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Agricultural Wages Board.

THE Minister of Agriculture, having received from the organisations representing employers and workers the names of the persons nominated to serve as members representing employers and workers in agriculture on the Agricultural Wages Board, has duly established the Board by an Order dated 18th October, 1924.

The full list of members is as follows:—

Members appointed by the Minister:—

The Rt. Hon. the Lord Kenyon, K.C.V.O. (Chairman).
Mr. A. W. Ashby.
Mr. C. S. Orwin.
Mr. J. Willmot, P.P.S.I.
Mrs. M. Wintringham.

Representatives of Employers (nominated by the National Farmers' Union):—

Mr. D. Black.
Mr. M. T. Davies.
Mr. H. German.
Mr. E. W. Langford.
Mr. E. Lawrence.
Mr. J. Rimmer.
Mr. R. R. Robbins, C.B.E.
Mr. T. H. Ryland.

Representatives of Workers (nominated by the National Union of Agricultural Workers and by the Workers' Union):—

Mr. G. Edwards, O.B.E.
Mr. G. E. Hewitt.
Mr. W. Holmes.
Mr. E. J. Pay.
Mr. R. B. Walker.
Mr. J. Beard.
Mr. G. Dallas.
Mr. W. Williams.

Mr. R. E. Stanley, of the Ministry of Agriculture and Fisheries, has been appointed Secretary to the Board.

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Agricultural Wages Committees.

THE Minister of Agriculture, having received from the organisations representing employers and workers the names of persons nominated by the organisations to act as representative members on the Agricultural Wages Committees, has now formally established these Committees in accordance with the Agricultural Wages (Regulation) Act.

As provided by the Act, 47 Agricultural Wages Committees have been established, 32 of which operate in single counties only, while 15 cover two combined counties each. The total number of representative members nominated by the employers and workers together is 630, 315 members representing employers being nominated by the National Farmers' Union and 315 members representing workers by the National Union of Agricultural Workers and the Workers' Union in proportions agreed between those two Unions. The number of representative members on each Committee varies from 12 to 16. In addition to the representative members, two impartial members have been appointed by the Minister to each Committee.

The Committees were all established on the 18th October, 1924, and their first business will be the election of Chairmen, and meetings for this purpose are being arranged to suit the convenience of members. When the Chairman has been appointed each Committee will be in a position to consider the fixation of minimum rates of wages in its area.

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Young Farmers' Clubs.

THE cattle judging competition by members of Young Farmers' Clubs is becoming a recognised feature of the Dairy Show. The event this year had special significance since it formed the occasion of a public announcement of the intention of the Ministry to undertake general supervision of the movement.

On the morning of the 23rd October the competing teams, together with their club leaders (Messrs. Broughton, Earl, Goddard, Mitchell, Noakes, Paget and White) and officials interested in the club activities, met at 10, Whitehall Place and were addressed by Mr. H. E. Dale, C.B. (Assistant Secretary to the Ministry). Mr. Dale referred to the pioneer work of the *Daily Mail* and expressed appreciation of the present value and future possibilities of the movement. He explained that direction by the Ministry would not involve alteration of present club policy (financial or otherwise), since it would be essential that the clubs should continue to be autonomous and self supporting. In addition to the technical advice and help already available from county sources, the services of officers of the Ministry would assist the development of the clubs. Mr. Tustin, speaking from long association with young farmers, voiced the gratification of those present at the Ministry's decision. He emphasised the important character of the honorary work performed by club leaders and pointed out that an annual meeting of these officers would be a helpful innovation. Mr. Dallinger, O.B.E., extended a hearty welcome to the teams and said that he looked forward with confidence to an increased entry next year.

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The Drying of Seed-Corn.

IN a season such as we have lately experienced a great deal of corn is necessarily harvested in a damp condition. The question naturally arises how far the grain can be improved for seeding purposes—as it is for milling and malting—by artificial drying. An article on this subject, contributed from the Official

Seed Testing Station, was published in this *Journal* for July, 1919.

Trials, more or less on the same lines as those referred to in the article mentioned, have been undertaken recently at the Official Seed Testing Station at Cambridge, where each sample of wheat is being tested as received, a further test on a portion of the sample being made after drying for four days at a temperature of 40° C. (104° F.). The drying frequently results in increasing germination by from 10 to 15 per cent., while with the dried seed the germination is usually more rapid and even.

There is no doubt that considerable care must be taken in storing damp wheat, especially if it is to be kept for any length of time, otherwise considerable loss of germination may take place. On the other hand, artificial drying requires very careful doing, and the use of very delicately adjusted instruments for control of temperature. Seed-merchants and maltsters possess the requisite skill and apparatus, but the grower who cannot arrange to have his seed dried by experts must be content with simpler methods. He should endeavour to get his wheat as dry as possible in the stack, before thrashing, and afterwards should spread the grain in a shallow layer in a dry but draughty loft and turn it frequently. It would scarcely be wise for him without previous experience to attempt to dry the seed in a hop-kiln or otherwise. It may be added that beans and peas which are to be stored should likewise be dried by being spread out in a loft. Otherwise there is a danger of their becoming mouldy.

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Foot-and-Mouth Disease in California.

THE method of eradication adopted by the United States Government has kept that country free from foot-and-mouth disease except for occasional invasions. Previous outbreaks occurred in 1902, 1908 and 1914 and the most recent outbreak commenced at the end of February this year. The method practised is similar in principle to that employed in Great Britain, and consists of prompt slaughter of all affected and contact susceptible stock, combined with control of movement into, within or out of a surrounding scheduled or "quarantined" area.

The successful eradication of disease in previous outbreaks in the United States has fully justified the slaughter policy, and in the recent outbreak the entire cost of eradicating the disease promises to be extremely small when compared with losses

occurring annually in countries where the disease is endemic. The vigorous action of the Government appears to have succeeded in overcoming the disease in California, and the situation at the end of August was very favourable for its early eradication.

During May the disease reached Orange county, which is separated from the Mexican border by only one county. Had Mexico become infected it is possible that the disease there would have become endemic, and Mexico would have become a reservoir of disease from which the United States would be periodically invaded.

In brief, the history of the present outbreaks is as follows: Foot-and-mouth disease first appeared in the vicinity of Oakland on 26th February, and the rapid spread of infection in the three original counties of Alameda, Contra Costa and Solano was traceable in nearly every instance to the movement of persons or live stock. Five counties were "quarantined" by order of the United States Department of Agriculture which imposed restrictions on the movement of susceptible stock and also of carcasses, hides, wool, hay and straw and similar fodder.

On 22nd March disease was discovered in a large herd of cattle in a semi-range district in Merced county. Infection is thought to have been conveyed there from Contra Costa county by human agency. San Francisco, San Joaquin, Kern and Los Angeles counties became infected through the movement of animals for slaughter from Merced just before the discovery of disease there. From these new foci infection continued to spread and on 8th June the total number of counties in which disease had appeared numbered 16.

The outbreak in the three original counties was soon brought under control, no case occurring after 23rd March except in Contra Costa. In that county the last case was on 7th May, and the continuation of disease was due to stray animals in a very broken section of the county. This section was finally cleared by 11th May.

At mid-September no case of the disease had been recorded in the State since the middle of June except in the counties of Los Angeles and Tuolumne. Tuolumne county has presented unusual difficulties in the work of eradication throughout the entire outbreak. This is due to the wild and rugged character of the district, which contains forests, canyons and high mountain peaks, and transit is largely by horse. Even in this county, however, all known diseased herds have been slaughtered and buried. The range cattle in the less accessible parts are sur-

rounded by "pickets" and a large force of veterinary surgeons working from a central camp is constantly engaged on the work of inspection. The total number of animals slaughtered as affected or exposed to infection during this outbreak in California up to 14th September is 107,805, comprising 57,557 cattle, 21,014 pigs, 28,397 sheep and 837 goats.

On 26th September an outbreak of the disease occurred on a ranch in Harris County in the coast region of Texas, an area of some size being found affected. Four counties have been quarantined, and some 3,000 animals slaughtered in this area.

Dr. R. Mohler, Chief of the Bureau of Animal Industry, United States Department of Agriculture, in a notice to the Press deals with this subject as follows:—

"The most serious obstacle to the work, surprising as it may seem, is the recklessness of many livestock owners in admitting cattle buyers and traders to their premises. The quarantine guards, though sufficient in number for enforcing all reasonable quarantine measures, obviously cannot control the movements of all persons. In several instances the disease has appeared soon after cattle buyers from an exposed region visited farms that were at a safe distance from the nearest infection. In one instance it was necessary to quarantine an entire county because infection had appeared as the result of this practice.

"The chief aid which the livestock industry can give the speedy eradication of foot-and-mouth disease is more thorough co-operation in stopping visiting and travel in the neighbourhood of infected or exposed premises. The risk cannot be emphasised too much."

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An International Institute of Co-operation.

A DEVELOPMENT of considerable significance in agricultural co-operation is the decision reached unanimously at a meeting of farmers' organisations and co-operative undertakings held at the Department of Agriculture, Washington, U.S.A., and attended by the late Secretary for Agriculture, Mr. Wallace, to hold a conference for the purpose of founding an International Institute of Co-operation in the United States in the summer of 1925.

The project is purely educational. In a memorandum setting out the aims and purposes of the Institute, its promoters observe that the general conception of the principles underlying the co-operative movement is vague, uncertain and idealistic, and that a more thorough understanding of the

theory, history and technique of co-operation is necessary if the successful application of these principles, and the realisation of their acknowledged possibilities for good to the business interests and general welfare of the country are to be accelerated. "Co-operation," they say, "is being advocated as a business practice by those whose ideas of it are indefinite and varying. There is a dearth of responsible information respecting its operation or results, though a considerable amount of literature is appearing more in the nature of propaganda than sound or constructive information or criticism. Educational institutions lack data and trained men for the scientific investigation, analysis and presentation of this movement.

"All over the country men are trying to set up and operate business enterprises based on this principle with little knowledge of what it is, how it should be applied, how it works, or in what it will result.

"The great consuming public has or easily may have an utter misconception of this movement as something aimed at their exploitation by the producing class, whose efforts to apply the co-operative principle to the marketing of crops have attracted wide attention.

"The present need, as some of us see it, is for some agency through which the public at large and those especially involved may obtain a better, more uniform and reliable knowledge of co-operation, its history and practical operation."

The immediate objects of the session of 1925 are stated to be:—

1. To collect and make available a body of knowledge concerning the co-operative movement in the United States and in other lands.
2. To serve as a means of clarifying thought as to what the co-operative movement really is, and of bringing about more harmony and unity of action among organisations directly or indirectly connected with co-operation.
3. To serve as a means of training and developing leaders and workers in respect to co-operative theory and practice.
4. To serve as a means of assisting educational institutions to improve their teaching courses in co-operation.
5. To focus the spirit of the co-operative movement as a means of community and national development.

The session will last about four weeks, and it is the intention of the organisers to invite to America for the purpose, the

leading authorities on the co-operative movement in various parts of the world, as well as a number of students.

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Lectures on Agricultural Research.

MANY farmers doubtless find it very difficult to arrange to visit Agricultural Research Institutes in order to familiarise themselves, at first hand, with the work which is being carried on for their benefit by agricultural scientists. The Ministry therefore endeavours in many other ways to bring before farmers the results of agricultural research, viz., by its Advisory Scheme, in which college and county staffs play their part; by leaflets and by articles in this *Journal*; and by publications such as those on "Agricultural Research and the Farmer" and "Studies in the Handling of Milk." There is, however, still need for personal contact between the rank and file of farmers and agricultural research workers. To provide opportunities for such personal contact a scheme was organised by the Ministry, in co-operation with the National Farmers' Union, under which meetings arranged by branches of the latter body are addressed by specialists in the various branches of agricultural science. The scheme started on an experimental basis in the winter of 1922-23, and succeeded so well on being continued in the winter of 1923-24, that not only will it be repeated during the coming winter, but it bids fair to obtain a permanent place in the organisation of the work of the Ministry.

In the winter of 1923-24 46 lectures were given by 20 lecturers to audiences totalling some 2,500 to 3,000 farmers (averaging about 60 per meeting), at 34 centres in 18 counties. The lecturers were drawn from most of the Agricultural Research Institutes, and also from the Ministry's Staff. The subjects were chosen by the branches of the National Farmers' Union, and the following list indicates their relative popularity :—

Animal Feeding, including Dairying	16	lectures.
Cropping including Grasses	9	"
Plant Diseases and Weeds	6	"
Animal Diseases	5	"
Soils and Manuring	4	"
Plant Breeding	3	"
Economics	3	"

For the winter of 1924-25 a provisional list of centres and lectures has already been drawn up. Some 40 lectures will be

given, and the subjects chosen by branches of the National Farmers' Union are as follows:—

Animal Nutrition and Dairying	9 lectures.
Animal Diseases	8 "
Plant Breeding	6 "
Soils and Manuring	5 "
Economics	3 "
Plant Diseases	3 "
Fruit Growing	2 "
Engineering	1 "
Small Livestock	1 "

Inquiries in connection with this scheme should be addressed by farmers to the Secretary of the local branch of the National Farmers' Union.

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Guide to Clean Milk Competitions.

ONE of the Ministry's series of Miscellaneous Publications (No. 43, *Guide to Clean Milk Competitions*),* only recently issued, was originally prepared to assist the organisers of and officials concerned with Clean Milk Competitions, and accordingly only a small edition was printed. It has now been represented to the Ministry that the information in this pamphlet will be of great interest and value to competitors also, and to all who are attempting to improve the quality as well as increase the quantity of milk.

The Ministry has therefore felt justified in printing a further and much larger edition, and in reducing the price to 6d., in the hope that those taking part in Clean Milk Competitions, and milk producers generally, will send for a copy.

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The Agricultural Index Number.

A FURTHER slight rise was recorded in the general level of prices of agricultural produce during September, the general average over the month being 60 per cent. higher than in the corresponding month before the war, as compared with the figure of 59 per cent. above the pre-war level which was recorded for August. The rise in September was hardly so pronounced as that which occurred in the same period in 1923, but prices on the whole were still 4 points higher than in September last

* Obtainable from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. Price 6d., post free.

year, and for the first time since the fall in prices first commenced, were also higher than two years earlier.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	59
September	202	116	57	56	60
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Wheat averaged 12s. 1d. and oats 9s. 4d. per cwt. during September, reductions of 8d. and 4d. respectively as compared with August averages, but a fall is usual at this season owing to the increasing quantities of home-grown corn coming on to the market, and the index numbers consequently show a rise of 2 points in one case, and no change in the other. Barley, on the other hand, normally increases in price during the early months of the season, owing to the improvement in quality and the larger proportion of malting barley included in the total quantity marketed. This season is no exception to this rule, but the unfavourable weather conditions of recent months have reduced the quantity of good malting barley available, and prices have consequently risen very sharply; during September barley averaged 17s. 3d. per cwt., 4s. more than in the previous month, and the general level was no less than 107 per cent. higher than the average of the three Septembers of 1911 to 1913. Barley is now the dearest of all kinds of produce sold off the farm.

Fat stock showed comparatively little change as compared with August. Cattle declined slightly, and sheep were unchanged, but pigs continued the recovery which was recorded in August, advancing by 5 points on the month. Fat sheep are at about double their pre-war value, and, after barley, are the dearest commodity produced by the farmer, in comparison with pre-war prices. Pigs, however, are distinctly below the general level of all commodities, while fat cattle are somewhat below the general average.

Dairy cows advanced by 16s. per head in September as compared with August prices, but the advance is partly seasonal and the index number has risen only 2 points. Store cattle, on the other hand, which usually tend towards higher prices at this season, were distinctly cheaper in September than in the previous month, and a decline of no less than 10 points is recorded by the index number. Neither store sheep nor store pigs show any material change; the index number for store sheep is decidedly higher than that for fat sheep, but store pigs are relatively cheaper than fat, due in the one case to the firmness of the market for fat sheep, combined with prospects of good root crops, and in the other to the depressed condition of the fat pig trade and the high prices now ruling for nearly all descriptions of feeding stuffs as compared with pig prices.

Milk shows no alteration on the month, but the shortage of good quality imported butter is reflected in the index number for British butter, which has again advanced and is 72 per cent. dearer than in 1911-13. Cheese is much cheaper, owing chiefly to the fact that quotations are now entirely for new cheese.

Eggs are seasonally dearer, and the advance is greater than in the basic years, with a corresponding rise of 8 points in the index number, while dressed poultry shows an advance of 9 points, due mainly to a rise of 1s. 8d. per head in the average price of geese.

Apart from the sharp increase in barley the chief feature of interest in September was the rise in potato prices. Usually prices fall sharply after the opening of the season, and main crop potatoes in September realise appreciably less than the early varieties which form the bulk of the supplies in July and August. This year, however, although August showed a fall, prices of main crop potatoes were higher in September than earlies in August, averaging £7 7s. per ton, and the index number is 27 points up on the month at 99 per cent. above pre-war.

Hay prices show no change and are still only a shade higher than before the war. Fruit and vegetables both show substantial decreases on the month. Fruit, which during August realised about 133 per cent. above pre-war prices, during September made only 93 per cent. more than in September, 1911 to 1913, owing partly to a fall in apple prices and partly to the arrival of pears on the market, these being plentiful and cheap; plums, on the other hand, remained dear at more than three times their pre-war price. Vegetables generally were only 19 per cent.

dearer in September than in the corresponding month before the war, as compared with an increase of 47 per cent. over pre-war in the preceding month. Cabbages were obtainable at pre-war prices, while cauliflowers, carrots and celery were 23, 16 and 38 per cent. respectively dearer than before the war.

Comparison of the September figures for the last three years shows distinctly the improvement in the position of vegetable foods as contrasted with animal products. In 1922 cereals ranged from 23 to 31 per cent. and in 1923 from 19 to 30 per cent. above pre-war; now the range is from 38 to 107 per cent. above, while the relatively cheapest crop, oats, is mainly retained for feeding to farm stock. Potatoes also have risen from about their pre-war level in 1922 to 75 per cent. above in 1923 and to about double pre-war in September this year. Hay alone among vegetable products is relatively cheaper than a year and two years ago. As opposed to this, although fat sheep are rather dearer than in the two previous years, pigs are decidedly cheaper, while cattle are cheaper than in 1922 and dearer than in 1923. Dairy produce and poultry products, although not uniformly cheaper than in the two earlier years, are, on the whole, realising less money.

Index numbers of different commodities during recent months and in September, 1922 and 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1922.	1923.	1924.			
Commodity.	Sept.	Sept.	June.	July.	Aug.	Sept.
Wheat ...	23	19	42	47	59	61
Barley ...	26	30	48	52	75	107
Oats	31	30	32	28	38	38
Fat cattle ...	58	45	55	54	56	54
Fat sheep ...	90	72	93	97	100	100
Fat pigs ...	84	55	31	31	34	39
Dairy cows ...	63	52	59	55	57	59
Store cattle ...	33	27	47	51	48	38
Store sheep ...	109	109	121	132	129	130
Store pigs ...	125	95	32	28	29	29
Eggs... ...	96	75	43	65	63	71
Poultry ...	85	67	93	80	66	75
Milk	70	67	50	50	58	58
Butter ...	76	56	43	60	67	72
Cheese ...	41	74	83	90	66	42
Potatoes ...	1	75	174	81	72	99
Hay	52	32	3	1	3	1

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LOANS FOR THE PURCHASE OF LIME.

A GREAT deal of agricultural land in this country is in urgent need of lime, and cannot produce proper crops or make use of the manure it receives owing to the lack of lime in the soil. In the term "lime," we include all forms of lime and carbonate of lime, *e.g.*, shell or cob and ground lime, ground limestone or chalk, etc. Farmers have for many years tended to neglect the practice of liming for various reasons. In many cases the soil had originally been limed and has slowly become exhausted though the process has been gradual and there has been no sudden change to show how the productive power of the land has been impaired. Then the initial cost of the operation is high and involves an outlay of capital which farmers can ill spare. Again, the benefits do not begin to accrue till the second or third year after application. Further, whilst the benefits are undoubted and the return to be obtained is well worth the outlay, the farmer can continue to get crops of a sort without it.

The Ministry cannot make loans to individual farmers to enable them to purchase lime, but it can make loans to associations of farmers under the Agricultural Credits Act, 1923. The system on which such loans can be made is, however, prescribed by the Act and necessitates the formation of an Agricultural Credit Society and the subscription of a certain amount of capital by the borrowers themselves, or by others, the intention being that the societies should be financed partly by the paid-up capital on shares taken by members and partly by money advanced by the State. Parliament in short took the view that whilst it was reasonable to provide a substantial portion of the money required, the persons interested must themselves make some contribution in cash and also offer the security of a liability to pay if required the uncalled balance of their shares.

The manner in which this system might be applied to enable farmers to purchase lime co-operatively, and to obtain credit from the Government for this purpose is as follows.

It would be necessary, in the first place, for a number of farmers to agree to combine together to form a Co-operative Credit Society to be registered under the Industrial and Provident Societies Acts, which would combine the purpose of buying lime and obtaining credit under the Agricultural Credits Act, 1923. Before actually proceeding to form the Society the Committee would obtain an estimate from its members of their individual

requirements of lime, and would make an estimate of the gross cost (including delivery) of the lime to be purchased and of any other necessary handling and clerical expenses. It could then inform the members of the number of shares in the Society which each would need to hold in order to qualify for the loan required to cover the expense of purchase, etc., and with their agreement could proceed to register the Society.

The loan to each member would be utilised for the purchase and distribution of the lime through the Society, and would have to be repaid to the Society on the basis of a scale to be calculated—so much per ton per annum (or per half-year) spread over five years or a less period. This scale would have to be calculated so as to cover the estimated expense of purchase and distribution of the lime and the interest on the advances from the Ministry; in other words the members would pay for their lime on an annuity or an instalment system spread over a period of five years or less.

The adoption of this plan would reduce the scheme to a very simple form. In effect it would provide the means of supplying farmers with lime on an "easy payment system" through co-operative channels. The farmer would know in advance what he would have to pay each year or half-year, and he would reap the double benefit of obtaining lime at wholesale prices and getting credit at a much lower rate of interest than most commercial houses allow.

There are certain limitations imposed by the Act in regard to the advances made to Societies. For example, the total sum advanced by the Government to any Society is limited to an amount equal to one pound for every pound share held by members of the Society on which a sum of 5s. has been paid. Thus, a Society whose members had subscribed for 2,000 one pound shares would be eligible for advances from the Government up to £2,000, and as the paid-up capital on the 2,000 shares would be £500 there would be a total sum of £2,500 available for loans to members.

The advances made to members of a Society are limited by the Act so that an advance to any member shall not exceed one-tenth part of the share capital of the Society, or an amount equal to £5 for every one pound share held by the member on which a sum of 5s. has been paid. Thus, in the example given above of a Society with 2,000 shares, the amount of the loan to any one member could not exceed £200, while in order to be eligible to borrow £200 the member in question would have to

hold as a minimum qualification 40 shares on which 5s. each had been paid, that is to say, he would have to contribute £10 to the funds of the Society.

If an association of farmers was formed as suggested above for the purpose of purchasing lime, the following is an example of the way in which the conditions imposed by the Act would work out. Assuming that a group of 30 farmers wished to purchase between them 600 tons of lime at a cost, including cartage and clerical expenses, of, say, £900, they would have to subscribe an *average* of £6 each (24 shares), while the loan from the Government would be £720 and the total funds available £900 :—

30 members subscribing 24 shares each equals 720 shares (5s. paid up) equals	£180
Government loan on 720 shares equals	£720
Total funds available	£900

The interest payable on the Government loan of £720 at the rate of 4 per cent. would be £28 16s. per annum, a sum which would be reduced as the loan was repaid.

It is assumed in the above example that all the expenses of the Society would be met from the £900, and that the Society is formed for this single purpose of supplying the members with agreed quantities of lime with repayment over five years. In such a case all that the members have got to do is to repay the £720 lent to them by the Government plus the annual interest. The balance of the Society's expenditure would be covered by the capital they originally subscribed, and when the loan was repaid the Society could be wound up, any surplus remaining being divided among the members.

The only liability assumed by a member of a Society, other than his obligation to pay off the loan made to him, would be one due to the default of some other member and would be limited by the amount of the uncalled share capital. If, for example, in the above case it had proved impossible to recover any payments from one of the members to whom 20 tons of lime had been supplied, whereby the Society would be approximately £15 out of pocket, a call of something like 6d. a share on the members would have to be made in order to complete the repayment of the Government loan. Of course a Society can sue for its debts like any other corporation, but if reasonable discretion were exercised in its original choice of members the risk of bad debts ought to be of the smallest.

Thus in the above example the Society could decide to repay at the rate of £180 per annum or £6 per member. In the first year this would be slightly more than one-fifth of the principal plus the interest in that year ($\frac{720}{5}$ = £144 + £28 16s. = £172 16s.). In subsequent years as the annual interest was reduced there would be a further balance on the right side available for paying off the principal. By the end of the fourth year £635 would have been repaid and the balance remaining would be £85 plus about £3 8s. interest or rather less than £3 per member.

The position at the end of the fifth year would be that the average member of the Society in question would have borrowed £30, with which he would have purchased through the Society 20 tons of lime. He would have subscribed £6 in the first instance as share capital, and he would have repaid £27 in instalments over five years, making £33 in all. Thus the net interest on the loan over five years would be £3 and he would have had the lime on his land during that period, and under ordinary circumstances the increased value of the yield should undoubtedly make the transaction a remunerative one.

The above example is based on the assumption that all the members of the Society are prospective borrowers, and that they all want to borrow at the same time, and for this single purpose, the Society coming to an end when the members have repaid their loans. The only limitation imposed by the Act in a case of this sort is that the loan to any individual member should not exceed one-tenth of the share capital, *i.e.*, in the above example, £72.

A single-purpose Society of this kind could of course be established for any other object of the kind contemplated by the Act. The alternative type of Society is one of a more permanent character where loans are made to members from time to time and the share capital is invested by members who receive interest on it as an investment.

Further particulars as to the formation of Agricultural Credit Societies of the latter type, rates of interest, repayment, etc., are give in Leaflet 311, a copy of which can be obtained on application by those interested.

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HOME-GROWN WHEAT FOR BREAD-MAKING: THE VALUE OF IMPROVED VARIETIES.

ENGLISH wheat has qualities of outstanding merit when milled into flour for biscuit-making and for household purposes, while there is an increasing demand for it as a poultry food. The bulk of the wheat delivered to flour-mills is, however, milled into flour for bread-making, and, for this purpose, the commoner varieties of English wheats are not, as a rule, able to compete on equal terms with the wheat imported from Canada and other countries.

The main factor in determining the price of both home-grown and imported wheat is the quality of the respective samples. For bread-making purposes, wheat must make a threefold appeal on its quality; (1) to the miller, (2) as flour, to the baker, and (3) as bread, to the consumer. The price the miller is prepared to give for wheat is affected by its moisture content and percentage of flour extraction. The " strength " of the flour produced is primarily the concern of the baker, while the consumer, for his part, judges the loaf mainly on its appearance and palatability.

It may be of interest to examine these qualities in detail, with a view to comparing the improved varieties of wheat now being grown in this country with the commoner varieties, and with the wheats usually imported.

(1) **Wheat:** *Moisture Content.*—Before milling, it is necessary to " temper " or " condition " the wheat. This is a process of washing and drying the grain, which, when there is a large percentage of moisture present, may involve a considerable loss in weight. The matter is therefore one of great consequence to the miller. Dry grains, on the other hand, absorb moisture in this process. For example, a milling test made for the purpose of comparing Canadian and home-grown wheat, showed that Manitoba No. 1, before conditioning, contained 13 per cent. of moisture and home-grown wheat 19 per cent. After conditioning, the Manitoba wheat contained 16.8 per cent., a gain of 3.8 per cent., and home-grown wheat 16 per cent., a loss of 3 per cent. Experience shows that, on the average, imported wheats contain from 10 to 15 per cent. of moisture and home-grown wheats 15 to 22 per cent. in an ordinary season. These percentages are subject to considerable variation from year to year and from month to month. Unfortunately, moisture

content appears to be governed almost entirely by climatic and soil conditions. In this respect the improved varieties can show no substantial advantage over the commoner varieties grown in this country; and both stand at a relative disadvantage in comparison with the imported article. This, however, as will be shown, is the only respect in which the improved varieties of English wheat are unable to show better results in comparison with the commoner sorts.

Flour Extraction.—In the process of extracting the flour from the wheat, it is important that the branny husk should separate easily from the kernel. In this respect, the *average* home-grown wheat compares unfavourably with imported varieties. On the other hand, the "Yeoman" varieties of English wheat behave in the same way as the better Canadian sorts. Thus, the average percentage of flour extracted from the "Yeoman" wheats is, say, 1 or 2 per cent. higher than that obtained from the older varieties.

(2) **Flour.**—*Strength.*—By "strength" is understood the quality in a flour which permits of the formation of large shapely loaves of good texture. Incidentally, strong flours can better withstand adverse conditions of atmosphere and wider variations in baking methods than the weaker sorts. In the main, the size and shapeliness of the loaf will depend on the way the doughs behave during fermentation, the quantity of gas evolved during the later stages of fermentation, on the power of gas-retention of the doughs, and on their distensibility.

The true measure of strength is the volume of the loaf which will be produced from a given quantity of flour, and the number of loaves (4-lb.) which can be produced from a sack of flour. In a general way, it may be said that whilst a sack (280 lb.) of average all-English flour will make 88-90 4-lb. tin loaves, flour from the improved varieties, especially "Yeoman," will yield a larger number, say 90 to 92, so that, judged by the volume of the loaf produced and other baking qualities of the flour, "Yeoman" is a strong wheat compared with the average home-grown varieties.

In general, flour for bread-making in the larger urban districts consists of a mixture of 20-15 per cent. of weak wheats and 80-85 per cent. of strong wheats. In country areas, it is not uncommon to employ as much as 40-50 per cent. of the older English varieties in an average season, in conjunction with imported wheat flours. With "Yeoman" it is possible to raise the proportion of flour from home-grown wheat to

60-70 per cent. It is believed that in an average or good season, it will even be possible to use "Yeoman II" by itself in the production of bread flours. It follows that, having regard to the unlimited demand for strong wheats for bread-making, the more the cultivation of the improved varieties, such as "Yeoman," spreads, the more extensively will home-grown wheat be in demand both by the miller and the baker.

(3) **Bread.**—*Appearance and Palatability* are the qualities which appeal most to the general public. For flavour, English wheats of whatever variety generally excel imported varieties, and it may be said, broadly, that the greater the proportion of home-grown wheat flour which a loaf contains, the better flavour it has, and, further, that the greater the proportion of improved varieties, the better the colour and texture, and the more atractive it becomes to the consumer.

General.—The farmers of this country thus have at their disposal varieties of wheat which possess the qualities most desired by the miller, the baker and the general public. From the farmer's standpoint, moreover, there is now sufficient experience to show that for the many kinds of soil and other conditions which exist in this country, "Yeoman" is as generally suitable as any other variety, and more suitable than most. Results necessarily vary, and no one variety can be expected to be pre-eminently suitable for every type of soil. Although "Yeoman" and other improved varieties are believed to form a substantial proportion of the 1924 crop, there is no reason why its cultivation should not be rapidly extended.

Biscuit-making.—Ordinary varieties of English wheat are, as a whole, more suitable for biscuit-making than imported wheats and even than the "Yeoman" varieties. Hence, if "Yeoman" wheat is more generally grown, the supply of other varieties for biscuit-making will be reduced and these, in their turn, may realise a better price. The demand for flour for biscuit-making is, however, limited.

Economy of Distribution.—Another and important factor in the extended growth of the improved "Yeoman" varieties lies in the economy in distribution which will be effected. At present, the local miller or baker has to obtain a proportion of strong wheat or flour from the ports. When strong wheat, such as "Yeoman," is grown and ground locally, these transportation costs may be eliminated. The miller, for example, in such a case is saved the cost of bringing wheat from the ports,

and could afford to pay the farmer an improved price in consequence.

The most hopeful way, therefore, in which to make wheat-growing more profitable in this country, is for the farmer, whenever practicable, to grow the improved varieties now at his disposal.

Whilst the case for the cultivation of these new improved varieties of English wheat rests fundamentally on their better quality, and hence on the better price which the farmer should receive, nothing will stimulate their cultivation more than an increased demand for the resulting flour.

Good mixtures of English flour should not be difficult to obtain, and, in most cases, bakers should be in a position to supply bread made from the English article. To induce them to do so as a commercial proposition, there must be a sufficient demand from consumers at a satisfactory price. An all-English loaf is not necessarily cheaper than ordinary bread. If well-made of first-grade flour, the superior flavour may well justify a somewhat higher price in the estimation of those consumers with whom flavour in bread is the first essential, and who prefer the home-grown produce for what is signifies.

Summary.—1. Wheat growing in this country, especially in recent years, has not been profitable. The most hopeful way in which it can be made more remunerative is by improving the quality of the product, so as to realise a better price with the same productive costs.

2. There is an almost unlimited demand for "strong" wheats which have to be imported from abroad. The improved varieties of English wheat, such as "Yeoman" are "strong" wheats, capable of being substituted wholly or in part for the imported article, and, if milled near where they are grown, can compete on favourable terms with imported varieties owing to the saving of transport costs which results.

3. Apart from their use in substitution for imported varieties, the improved varieties of English wheat will produce a flour capable of making an excellent loaf, distinguished for its flavour Many consumers appreciate this quality, and bakers should find it commercially possible to meet a demand for an all-English loaf containing a substantial proportion of "Yeoman" flour.

4. Farmers, in order to meet the demand for strong English wheats, should increase the area of improved varieties cultivated. As a corollary, the better quality of the product should ensure higher prices.

ENSILAGE.—I.

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ENSILAGE has now become an important part of agricultural practice in the British Isles, and shows signs of steady development. The purpose of this and succeeding articles is to give a consecutive account of present-day knowledge of the subject, and of the methods practised in this country. Since some confusion exists in the use of the terms silage and ensilage, the author will adopt the suggestion of Mr. Jenkins in his report to the Royal Agricultural Society in 1884, "that the word ensilage should only be used to describe the process and that the product should be called silage."

History.—In several parts of the world, especially in dry countries, the ancients were in the habit of storing grain in pits in the ground. Amongst others Pliny mentions the practice and uses the Latin word *sirus* to describe such a silo or pit for storing grain. There is probably little doubt that ensilage owes its inception to similar practices. The process of making silage from green fodders in a succulent condition originated in central Europe, and the first account of it in this country occurs in the *Transactions of the Highland and Agricultural Society* of 1843. Ensilage is referred to by agricultural writers from time to time after this, and amongst others by Mr. Wrightson when reporting on the Agriculture of Austria-Hungary in the *Journal of the Royal Agricultural Society* for 1874 under the name of "sour hay." Wrightson recommended it to the attention of farmers in this country, but little or no attention was given to the subject till about the year 1882. About this time two facts combined to give a great stimulus to the practice—farmers were suffering from the bad times following 1879 and were the more ready to accept new ideas and new practices, and in 1882 a Frenchman, the Vicomte de Chezelles, paid a visit to the Royal Agricultural Society's Show at Reading and gave there an account of his methods of making silage. He had constructed in France a silo capable of holding upwards of 1,000 tons of silage, and in this had converted hundreds of acres of clover, tares, lucerne and grasses into silage.

During the next few years silos of many descriptions were constructed throughout the length and breadth of Great Britain, and silage of all descriptions, some good, some indifferent and

much bad, was made. An excellent description of the diversities of silo construction and silage practice in those days can be obtained from "Silos for British Fodder Crops," a book published by the sub-editor of the *Field* in 1884. These silos for the most part took the form of pits wholly or partly sunk in the ground, the horizontal section of which was generally greater than the vertical section. As a consequence of this the percentage of loss was high and the silage frequently sour.

In 1883-4 Mr. George Fry, F.L.S., described the results of some experiments which he conducted at Chobham in Surrey showing the conditions under which sweet silage could be produced by allowing the temperature of fermentation to reach 45° C. = 113° F., and Lord Walsingham in Norfolk and many others warmly advocated the practice. About this time Lawes and Gilbert at Rothamsted and Dr. Augustus Voelcker at Woburn carried out feeding experiments, which, however, yielded for the most part inconclusive results.

In 1885-6 a Royal Commission was appointed, heard abundance of evidence and issued a report, which, however, was not very helpful to the practice. After this period to the end of the 19th century ensilage languished till in 1900 it had almost disappeared from British farming.

During this same period ensilage had been introduced into North America where it at once gained a footing and has been continuously spreading ever since, till at the present time there are said to be well over three-quarters of a million silos in use in the United States, as well as many in Canada. It is interesting to inquire why the practice was successful in America and a failure in Britain. An analysis of the situation shows that there were several conditions different in the two countries: In early days the Americans hit upon the idea of the tall cylindrical silo, which greatly reduces wastage. The silage there was largely made in hot dry districts, in which it was impossible to grow roots economically. Their main silage crop, maize, can be grown to advantage under these conditions, is comparatively cheap to grow, and easily cut and ensiled. Added to this was of course the fact that labour was costly in America and cheap in England, so that the root crop in this country could be cheaply grown. Lastly, it should be noted that many investigators at the American agricultural colleges, and especially Babcock of Wisconsin, have been continuously studying the conditions for the successful making of silage, whereas no one in this country has continuously set himself to study the subject.

It was not till 1901 that Mr. F. B. Smith, C.M.G., then Vice-Principal of the South-Eastern Agricultural College, after a visit to the United States, brought back the idea of the cylindrical stave silo, and as a result one was erected on the College farm. He shortly afterwards went to South Africa, but Sir John Russell and his colleagues at Wye carried out a series of experiments with this silo, using the maize crop, and showed that under the conditions of their experiments the loss of dry matter in ensiling a crop of maize amounted to 36 per cent. These results were most unfortunate, because such a loss is not general and because they tended once more to delay the introduction of the practice of ensilage into this country.

In 1910 Mr. George Jaques, who had experience of silage in stave silos in Canada began to farm at Tivetshall in Norfolk, and soon erected a similar stave silo, which he filled with a mixed crop of oats and tares. In this he made successful silage, and by his advocacy the practice of making silage in tall cylindrical silos became established in the Eastern Counties and steadily spread until at the present time there are silos in almost every county of the British Isles, whilst several agricultural colleges and institutes are equipped with them and are engaged in studying the fundamental problems connected with the practice.

Quality in Silage and How to Control It.—A study of the literature at the time of the first silage boom shows that the pioneers at that time recognised only two types of silage, sweet and sour, and, as previously mentioned, Fry had shown that sweet, brown silage resulted when the temperature of fermentation exceeded 113° F. There was, however, one exception to this general statement, for a Frenchman, M. Goffort, is quoted* in 1884 as stating: " My maize, my green rye, my fodders of every kind have scarcely changed colour after eight or ten months of ensilage." From this it is obvious that the green silage of M. Goffort, which had scarcely changed colour, was different material from the " sweet, brown silage " advocated by Fry and equally different from sour silage.

In 1900 Babcock and Russell† at Wisconsin showed that " the popular opinion that good silage can only be made with considerable heat is erroneous." They were successful in making

* "Silos for British Crops," by the sub-editor of the *Field*.

† Babcock and Russell, Wisconsin Agricultural Experiment Station, 17th and 18th Annual Report, 1900.

good silage at temperatures which did not exceed 80° F., thus, as the authors say, "disproving Fry's theory, that a temperature of at least 120° F. was essential for good silage." Many American and other experimenters have obtained similar results, of which may be quoted those of Neidig,* who found that in a filled silo the maximum temperature at the centre as distinct from the top was 91° F., and that good maize silage resulted.

When experimental work was commenced upon silage at Cambridge in a stave silo, erected by Messrs. English Bros., of Wisbech, it soon became evident that the first problem to be solved was how to control the quality; for in two of the first three years the quality and smell of the product were such that the authorities of Girton College, the nearest building of which is situated 50 yards away to the east, constantly complained of the smell whilst the silage was being fed. Moreover, ours was not the only case in which the bad silage resulted from faulty practice, for several other cases came to notice, and in particular one from Lincolnshire is worth recording. In this case about 150 tons of silage were involved, and the quality was such that the owner could scarcely get his cowmen to handle or his stock to eat the product, and I myself, after handling it was unable to rid my hands of the unpleasant butyric smell for 36 hours!

A study of this question of quality in silage has been made at Cambridge in two ways: (1) by inspecting silage from a large number of silos and ascertaining the conditions under which each was made by the farmers concerned, and (2) by making accurate observations of the conditions of the crops as ensiled at Cambridge and subsequently observing the type of silage produced. In this way it has been possible to differentiate no less than 5 distinct types of silage as follows:—

1. Sweet, dark brown silage.
2. Acid, light brown or yellow-brown silage.
3. Green fruity silage.
4. Sour silage of several forms.
5. Musty silage.

Sweet, Dark Brown Silage.—This silage is produced, as Fry showed, when the temperature rises above 113° F., but cannot be produced if that temperature is not reached. It is frequently produced when silage is made in stacks, and in fact we are now feeding at Cambridge (August, 1924) sweet silage made from a heavy crop of ryegrass and clover which was cut for hay on 4th to 6th June, but wet weather setting in and the

* "Chemical Changes in Silage Fermentation," Iowa Agric. Exp. Station, Research Bulletin No. 16.

weather forecast being as bad as it could be, the crop was stacked as silage between 9th and 14th June. In this case the maximum temperature recorded was 140° F. Again, a shallow layer of sweet silage is frequently to be found between six inches and two feet below the surface in a tower silo when filled with oats and tares or grass or clover. This layer of sweet silage in tower silos is due to the fact that air has more ready access to the surface of the silage than to lower layers, and so encourages fermentation and heating. The following table of temperatures taken in 1917 at 3 different depths below the surface in a tower silo illustrates this fact. The filling of the silo was completed on 19th July.

Table I. Temperatures at varying Depths in Tower Silo.

	At 6 in. deg. F.	At 2 ft. deg. F.	At 5 ft. deg. F.
July 21st	120	91	81
23rd	151	96	90
25th	151	116	94
27th	148	121	95
29th	146	118	98
Aug. 2nd	—	—	98

When the silo was opened on 12th November the silage at a depth of 6 in., which in August was sweet silage, had subsequently turned mouldy owing to access of air; the silage at 2 ft., where the maximum temperature reached 121° F., had a uniformly dark brown colour and was characteristically sweet, though the quality changed almost immediately below this depth: and at 5 ft., where the maximum temperature reached only 98° F., the silage was a much paler brown in colour and acid in character.

Sweet silage is therefore produced when conditions are such that fermentation is facilitated by the presence of sufficient air so that the temperature rises above 113° F. Conditions contributing to this are:—

(1) A comparatively dry crop, either one that is dry from being mature, or from being allowed to dry somewhat after being cut. Such dry crops facilitate fermentation, both because they do not pack so tightly and thus allow air to penetrate the silo readily, and because the heat which is generated by fermentation has comparatively less moisture in the silage to heat and consequently the temperature rises more.

(2) Fermentation is facilitated by intermittent stacking or ensiling, which allows time for fermentation in each layer before the next layer is put on.

(3) Fermentation is facilitated when the outsides of the silage heap are exposed, as in stack silage, so that air can blow through the stack.

Sweet silage has a sweet, pleasant smell, similar to that of over-heated hay; it is generally comparatively dry, and is appetising to and readily eaten by cattle. On account, however, of the excessive fermentation it has lost more digestible food material than other forms of silage and is consequently somewhat wasteful in making. Though good, this is not the best form of silage food.

Acid, Light Brown or Yellow-Brown Silage.—This type of silage is generally found in tower silos when an oat and tare crop or a seeds crop has been ensiled. It requires no special precautions in making if the crop is reasonably mature when cut, and especially if wilted a few hours before carting, so that the crop contains 25 to 30 per cent. of dry material when ensiled. Brown silage is then almost sure to result. Many observations have shown that the maximum temperature coinciding with this type varies between 86° and 104° F. As a rule there is not much juice expressed from the silo when this type is being made. Acid, brown silage is also commonly made in clamp silos.

This silage has a yellow-brown to brown colour, and an acid though pleasant smell, largely due to the presence of acetic acid (the acid of vinegar), the yellowish types having the more pleasant smell. It is readily eaten by stock, which thrive upon it, and is to be recommended.

Green " Fruity " Silage.—This silage is much less common and has not generally been described by writers on the subject, although, as previously quoted, M. Goffort in 1884 was stating " my fodders of every kind have scarcely changed colour after 10 months of ensilage." This type can never have been commonly produced, and it was not till 1919 that the writer's attention was drawn to it—by Mr. Arnold Oliver, at Bures in Suffolk. In 1920 he repeated this type of silage under the following conditions:—the crop was cut in a medium condition of maturity, the oats being in full milk, the tare pods full grown in length but the seeds barely half formed. The crop was in each case carted and ensiled the same day as it was cut. A maximum thermometer inserted in the centre of the silage recorded 86° F. Similar silage has since been produced at Cambridge, both in small experimental silos and in the large commercial one when the foregoing conditions have been observed.

This type of silage has a green to olive-green colour, and a smell that is delicious—neither sweet nor sour, but best described

as "fresh' and "fruity." It is greedily eaten by stock, and Woodman* has recently shown that its digestible properties are very high.

Green silage suffers from one practical disadvantage: large quantities of juice are liable to be expressed and drain away from the freshly cut and barely mature crop when ensiled, and carry away with them soluble food material of a valuable character. Moreover, this juice if allowed to accumulate in the yard produces a stinking mass of putrid material. The juice has, however, been collected in a fresh condition and fed to both cattle and pigs with advantage. None the less it is a problem requiring investigation.

Sour Silage.—Sour silage has generally a dark brown or olive-brown colour, and a pungent and very unpleasant smell due largely to the presence of butyric acid. It is commonly made when a very immature and succulent crop is ensiled, because in this case the watery fodder packs down very closely in the silo and excludes the air to such an extent that little heating is possible. Thus crops of immature maize frequently give rise to sour silage. Again, sour silage is frequently found at the bottom of a clamp silo, especially if this has been carted in wet weather, because the trampling of horse and cart over the clamp as well as the superimposed weight of silage squeezes out the air and limits fermentation. Such cases may be obviated or the sourness reduced if the making of the silage proceeds slowly so that a certain amount of heating may occur in each layer of 3 or 4 feet before the next is put on.

A second form of sour silage may occur when a laid crop, such as oats or tares, having become partially rotten at the base, is ensiled, and especially if after cutting rain falls and rotting proceeds in the field. This putrefaction appears to continue in the silo, and a very evil-smelling silage may result. These were the conditions which led to the Lincolnshire case of sour silage quoted above in this article. If such conditions prevail, and the crop after cutting has begun to get rotten, it is desirable to let surplus water dry off the crop before it is ensiled.

One other form of sour silage is more rarely found. This has a pale yellow colour and a different though equally unpleasant smell. This smell is not the butyric acid smell and has not been identified. In the few cases when this yellowish, sour silage has been found it has occurred in isolated

* Woodman, *Journal of Agricultural Science*, 12, Part II, April, 1922.

spots amongst other sour silage and in each case the crop from which it was made was very immature. The conditions under which it is formed require further investigation.

Musty Silage.—One case only of musty silage has been observed; this was made from a very poor crop of oats and tares amongst which was growing a prodigious amount of charlock. The whole was allowed to become overmature before cutting, and the stems of the charlock were very woody. It was then allowed to dry in the field for 24 hours before ensiling. The consequence was that the chaffed fodder was very porous, being kept open by the stiff chaffed stalks of the charlock, and instead of the normal fermentation a large number of mouldy spots were produced and by their growth caused the silage to have a musty and ammoniacal smell, so much so that stock refused to eat the greater part of it. When for any reason the crop has been allowed to become overmature before cutting, it should on no account be allowed to dry in the field, but should be ensiled at once.

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DAIRY CO-OPERATION IN THE UNITED STATES.

THE great expansion in the co-operative marketing of milk in the United States during the last three years is particularly exemplified in the case of the New York milk zone, from which the New York City milk supplies are drawn. This zone covers, roughly, the country within a 400-mile radius of New York City, comprising New York State and sections of the adjoining States of Pennsylvania, New Jersey, Connecticut, Massachusetts and Vermont. Milk producers within this area have the benefit of the New York City fluid milk market.

Milk sent to the city for fluid consumption has to be produced under certain hygienic conditions, prescribed by the City Health Department, which, to some extent, increase the cost of production; and the milk so produced and delivered commands the highest price in the market. While the consumption of fluid milk in New York does not vary to any great extent, the production varies very considerably according to the season, being twice as great in the months of April, May and June as in the corresponding months of the autumn. Apart from this large seasonal surplus there is always an actual excess of production in the New York milk zone over fluid milk demands even in the short months of the year. In addition there is a varying daily surplus left in the hands of the distributors, who must carry

sufficient stock to meet the maximum daily demand for fluid milk.

All this surplus has to be manufactured into milk products, such as butter, cheese, evaporated milk, etc., but when so manufactured, it comes into competition with the produce of country and world markets, and commands a much lower price than that obtained for fluid milk. Milk products manufactured from milk produced in the "Middle West," for example, carry a lower production cost because the milk is produced on cheaper land, with cheaper feed and under less restricted conditions than are required by the New York fluid milk market. The problem of the dairy farmer in the New York milk zone is the problem of disposing of his surplus to the best advantage.

The large milk distributing firms of New York have maintained for many years receiving stations throughout the New York zone to enable them to secure sufficient milk to supply the requirements of the fluid milk market at the time of the lowest milk production in the autumn. From the dairy farmers under contract with them they took the whole of the milk produced by them during the year, and disposed of the surplus by manufacturing and marketing the resulting products. The distributors were accustomed to purchase at a price low enough to protect them on the portion of the product which they had to sell in a cheaper market. Under this arrangement producers received a flat rate for their milk, somewhat higher than they would receive if they were selling entirely for manufacturing, but not so high as if they were able to sell for the fluid milk market only.

The Dairymen's League.—The first move towards organisation among the producers came about in 1907, probably in consequence of a general grievance among dairymen that the prices for milk then prevailing did not afford a fair return for their labour and for the capital invested. This movement resulted in the incorporation in that year of the Dairymen's League, a joint stock corporation under New Jersey State laws, formed for the purpose of marketing collectively the produce of its members. Producers became members by purchasing stock in the company at the rate of 25 cents per cow, and they signed contracts appointing it their selling agent upon a fixed commission of 1 cent per 100 lb. of milk. The organisation grew very slowly, however, and it was not until 1916, when there were 13,000 stockholders, that the League started to sell its milk collectively. It had, meanwhile, been able to improve marketing conditions for its members, and compelled the distributors to bargain with its officers, month by month, as to the selling price of milk.

The War brought about an immense expansion in the League's operations; by 1921 the number of stockholders had risen to over 99,000. A great war export trade in all milk products had arisen, and so great was the demand for milk that it commanded almost as high a price for manufacturing purposes as in the fluid milk market. Although the production had risen in sympathy with the increased demand, the League found it comparatively easy to sell all its milk at a flat price, and for two or three years the surplus milk problem had practically disappeared. With the end of the War, however, the export business in milk products suddenly ceased, and the consequent great drop in milk consumption brought about a precarious situation in the dairy industry, which had now to deal not only with the ordinary seasonal surplus and daily surplus, but to cope also with a production greatly in excess of normal market requirements. Such a contingency had not been unforeseen, and the organisers of the League, in anticipation of it, had worked out a scheme for pooling the milk of all its members, so that it could sell the milk for a variety of uses and at a variety of prices as the market might demand, putting all the proceeds into one fund, which should be divided on an equal basis among the members. The scheme, in effect, distributed the burden of the low-priced surplus over all the members of the combination.

Pooling Organisation.—To give effect to this scheme a new organisation, the Dairymen's League Co-operative Association, was formed. The new association proceeded actively to obtain signed contracts on the new pooling system with producers who were members of the old League. In brief, each contractor authorises the Co-operative Association to sell his milk along with that of all the other contractors for such purposes as it deems best, to pool the proceeds and pay a *pro rata* portion to him, after deduction of a sum for running expenses, capital investment, etc.

The contract provides that a producer who refuses or neglects to deliver milk or its manufactured product to the Association shall pay 10 dollars per cow, and if the default continues for more than a month, an additional 3 dollars per cow. The producer has the right to give away or retain for his own use such of his milk or other dairy products as he may wish, but he may not sell any products contracted to the Association to any outside party unless they have been previously offered to and rejected by the Association or unless he has obtained the written consent of the Association to such sale. There is a further provision that

if the producer receives an offer of a higher price for his milk or products than he is obtaining from the Association he shall turn this offer over to the Association.

The producer also agrees to a deduction of one dollar a year from the proceeds of sales as a subscription to the "Dairymen's League News," the weekly paper issued by the Association. He also signs in duplicate as part of the contract an authority to the Association to collect all moneys due to him, this authority being required for production, if necessary, to distributors or customers to whom his milk and products have been delivered.

The Association under the terms of the contract may make deductions from the proceeds of its sales to create a special fund to repay loans; to be used in building warehouses or other necessary buildings; to purchase land and buildings; to secure necessary equipment; and to provide such working capital as the Association may deem necessary. For all money contributed to the special fund by means of these deductions the producer receives a certificate at the end of the year, and interest is payable to him on the contribution.

The producer receives his share of the proceeds realised from the milk and dairy products sold and paid for during one month, subject to the deductions authorised, on or before the 25th of the month following; and as soon after the end of the year as all milk and dairy products have been sold and pay received therefor, full settlement is made to the producers.

Results from Pooling.—The working of the contract in its financial results to the milk producers may be gauged from the Bulletin of 25th September, 1923, relating to the business done in August, 1923. These bulletins are issued monthly by the League to its members, and give the total sales for the previous month, details of the pool price for milk, a summary of the customary deductions, the amount due to the producer, balance sheets and other information about the League's business. The pool price is taken as the average price received per 100 lb. for all Grade B milk testing 3 per cent. of fat at the base zone 201-210 miles from New York City, either sold direct to dealers or dealt with in the League's own plant. There are variations paid above or below this pool price, due to grade, fat content, freight, hauling, etc.

The pool price per 100 lb. of milk for August, 1923, was \$2.18, equivalent (at average exchange January to October, 1923) to 9s. 5¾d. The deductions per 100 lb. work out as follows:—

Total administrative expenses		1.04
Expenses of Local Associations		.11
" " Sub-district organisation		.05
Advertising fund		1.04
Insurance fund against bad debts and other losses ...		.16
Depreciation in fixed assets, buildings, plant and good-will, etc.		1.04
		3.44
Extraordinary hauling charges		1.51
Credited to special (capital) fund to repay loans, for building, purchase of land and buildings, equipment, working capital, etc. (For these deductions producer receives at end of fiscal year certificate of indebtedness bearing 6 per cent. interest and maturing in five years)		5.22
Balance—being cash payment to producer	8	5.57
	9s.	5.74d.

The price received by the producer on his August, 1923, deliveries was approximately 11d. per gallon, apart from his share in the capital fund mentioned above.

In April, 1922, the Association handled about 40 per cent. of the milk produced in New York City and about 21 per cent. of the milk produced in the six States in which it operated. Some idea of the extent of its business may be gauged from its gross sales for July, 1923 (the amounts are taken on the equivalent of the average exchange rate January to October, 1923):—

Fluid milk sold to dealers		£1,059,766
Sales from plants operated by the Association:—		
Fluid and skim milk	£257,815	
Cream	32,534	
Homogenized mixtures	181	
Buttermilk	1,328	
Plain condensed milk	5,188	
Sweetened condensed milk:—		
Domestic	2,358	
Export	14,282	
Evaporated:—		
Domestic	98,263	
Export	1,185	
Sweetened skim:—		
Condensed (bulk)	8,280	
Whole preserved:—		
Bond (bulk)	12,362	
Skim powder	5,710	
Butter	13,180	
Cheese	14,879	
Pot cheese	571	
Casein	—	
Ice-cream	37,527	
		505,643
Total (for the month)		£1,565,409

The last item in the sales statement, relating to ice-cream, represents an important and rapidly developing section of the Association's business. The demand for ice-cream in the United States is very large, and its manufacture, unlike that of other milk products, has the advantage of not being subject to world competition.

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NOTES ON CLEAN MILK COMPETITIONS.

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IN England and Wales much milk is wasted through souring before it reaches the wholesale dairy; no accurate figures are available, but it was estimated a few years ago that between one and two per cent. of the milk supplied to certain towns and cities was unfit for consumption on arrival owing to souring. Such being the case, then the amount that sours in hot, sultry weather must be tremendous, and surely the time has already arrived for dairy farmers to adopt those methods of production which, if intelligently applied, will eliminate most, or all, premature souring.

That some stimulus is required to accelerate the adoption in the dairy of modern methods and the principles of sound hygiene is now apparent to many people, and it is interesting to note that the procedure now favoured has education and the demonstration of correct methods as its basis. Some wholesale dairy firms have realised the immense amount of money that the prevention of premature souring would save for farmers and the trade, and steps are being taken to remedy it by encouraging the production of milk of a superior quality. One large wholesale dairy in the Midlands now tests bacteriologically all the milk it receives, and pays a bonus periodically to those farmers who have consistently supplied the most hygienic article, and it must be remembered that this is the milk which keeps sweet longest. Another method is employed in Sussex; this is the running of clean milk competitions for those farmers who actually supply milk to the dairies concerned, and, of course, it is the bulk milk as supplied day by day which is tested.

The Organisation of Clean Milk Competitions.—The incentives described above only affect, however, those farmers who supply milk to the dairies concerned, and the main mass of dairy farmers is left untouched. Consequently, it is desir-

able that another stimulus be provided, and a suitable one is a clean milk competition run for a county or other large area by the agricultural education authorities. It is this type of competition which will be discussed below. Since almost every county has its agricultural officer, and perhaps an itinerant dairy instructress, it follows that a county is the most convenient unit for the organisation of clean milk competitions. Agricultural societies and milk recording societies can help, but the County Organiser is in the most favourable position, since by means of preliminary demonstrations and lectures he can get a " level start " at the beginning, and, as the competition progresses, extract from it a mine of useful information for propagation by lecture or written articles.

Tests Necessary.—It is the custom in clean milk competitions for the farmers themselves to take all routine samples and despatch them to the laboratory for examination, but in addition the inspecting judge takes one or more surprise samples as described later. The tests carried out on these samples are the determination of the keeping quality, the number of bacteria contained, and the degree of fæcal contamination by estimating the quantity of coliform bacilli present. Determinations of the butter fat and the visible dirt are frequently made in addition, although the former merely acts as a check on the sampling, so rendering the detection of any faking easier.

In addition to the above laboratory tests it is customary for the cows, sheds, dairy and methods of each competitor to be critically examined and score-carded. The inspector does not visit by appointment, but every visit he pays is a surprise one, and he takes a sample of milk each time for examination. There should be no great variation between the bacteriological character of the surprise and routine samples.

The opportunity of the farm inspector is a great one; the mere fact of his examining certain essential articles will, on most farms; cause additional care to be given to them, not merely while the competition lasts, but afterwards in many cases; once the seed has been sown it will not die entirely.

Still more useful work is done if the inspector notices faults, or methods capable of improvement, and comments on them in his reports. Another benefit from these inspections is that improvised sterilisation plant is frequently seen and described, and when it is pointed out that good results are obtained so easily, fresh farmers who have hitherto thought that expensive and elaborate equipment was essential, are tempted to start

The Publication of Results.—*Interim Reports.*—The original custom was to publish a short report after the competition had ended, epitomising the period's work. However, in the Kent Clean Milk Competition (1923) Mr. G. H. Garrad introduced the innovation of sending out interim reports to each competitor when all competitors had submitted an equal number of samples for analysis. Mr. Garrad found that the Kent farmers were very anxious to know what results they were getting, so periodical reports were drawn up giving the complete results of every competitor, notes on the surprise farm inspections already completed and a short discourse on general principles and errors of frequent occurrence; care was taken to mention no names, but each farmer could pick out his own results by means of his code number, and, moreover, he could compare them with those obtained by other competitors. It was found that these reports were very carefully studied, and any information supplied was given to all competitors when they still had to supply the same number of samples before the competition ended. In this way much information of great importance was spread while the farmers' minds were eager for its reception and very anxious to apply it immediately. This procedure of issuing interim reports has since been started elsewhere.

Final Report.—These periodical statements do not render unnecessary the publication of a final report; in fact, it is highly desirable that one should be issued in all cases setting out the results of each round, and giving descriptions of good and bad technique, of efficient improvised apparatus used for overcoming specific conditions on individual farms, and so forth. Final reports also make it much easier to compare the results of one year with those of another, and of counties or areas in various parts of the country. By tabulating the marks given on the inspection score cards, it becomes possible to isolate those methods that are worst throughout a whole county, and to concentrate on their improvement. Some organising bodies could arrange for the publication of a handbook giving detailed results, and containing articles on the more salient features by the judges or other recognised authorities. Such booklets could be published in large numbers and paid for by the inclusion of advertisements of business firms selling agricultural commodities. Incidentally farmers could also advertise therein to their own benefit.

Do Clean Milk Competitions Effect any Improvement?— A careful study of the records available enables the writer to give an emphatic " yes " as the answer. The figures in Table I, extracted from the report of the Essex Agricultural Society's 1923 Clean Milk Competition, speak for themselves.

TABLE I.

Year of Competition	*Number of Competitors*	*Average Number of Bacteria per cubic centimetre*
1920	7	1,000,000
1921	9	150,000
1922	9	24,000
1923	16	30,000

In spite of several new competitors in the 1923 competition, the average bacterial count was comparatively low, and it is evident that the work of the three preceding years had brought out much educational material that had been put in practice by the fresh competitors of 1923.

In the 1923 Kent Clean Milk Competition the samples submitted for examination in each successive round had longer periods of sweetness in spite of hot weather at the end of the competition, as shown in Table II.

TABLE II.

Number of round	*Average period of sweetness at a constant temperature of 60°F.*
1	2 days 2 hours
2	2 " 5 "
3	2 " 7 "
4	2 " 15 "
5	2 " 17 "
6	2 " 23 "

It is worthy of note that the more prolonged keeping properties were obtained in the second half of the competition when competitors had got a grasp of the basic principles of clean milk production. In the competition period of three months fifty-three dairies in all parts of Kent had increased the period of sweetness of their milk by almost a day; surely the attainment of this object was worth while! More facts of the improvement effected in the county are described in the handbook " Clean Milk in Kent " published by the Kent Education Committee in conjunction with the Kent Milk Recording Society.

In conclusion several farmers known to the writer have been able to get a substantial increase above the market price for their milk, because they secured a high place in a clean milk competition: of course they have to maintain a high standard of quality and carry out their work efficiently. Clean milk competitions carry education to the cowshed, and it is there

that it is so much needed; they give the workers an intelligent interest in their daily work; and adaptations of the broad principles of hygiene, so assimilated, may be very useful to farmers when dealing with diseases of a contagious nature.

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THE INSTITUTE OF AGRICULTURAL ENGINEERING, UNIVERSITY OF OXFORD.

B. J. OWEN, M.Sc., M.Eng.,
Director of the Institute.

UNTIL the outbreak of war the Ministry had not found it necessary to take an active part in the development of agricultural machinery in this country. When however during the war the need for increased food production became apparent and a shortage of labour occurred in agricultural districts, efforts were made to stimulate farmers to make increased use of labour-aiding machinery. What at once became apparent was the lack of exact information about agricultural machinery—the best types to employ and the limits of their usefulness. In the result a good deal of money was spent on unsuitable machinery and a good deal of valuable machinery was improperly used. But the experience gained during the war years and those that followed has not only stimulated the use of agricultural machinery—it has emphasized the importance of an adequate knowledge of the principles underlying its use.

After the war a Departmental Committee was called together to advise on the further steps which should be taken to promote the development of agricultural machinery. As a consequence of the recommendations of this Committee the Ministry assumed for the time being the duty of conducting trials of agricultural machines and implements, together with some research work as occasion demanded. This was never regarded as more than a provisional arrangement. The policy of the Ministry in regard to research in all branches of agricultural science was definitely established; it was, on balance, considered wiser to hand over research problems to university institutions where the freer air and the greater facilities for contact with workers in kindred subjects were likely to promote and stimulate enquiry and investigation in a way almost impossible of realisation in a government department. And so after many discussions and after the ground had been explored afresh by a further departmental committee, the University of Oxford undertook the responsibility for fathering a new Institute of Agricultural

Engineering, which commenced to function in April of the present year. As the work requires a knowledge of both agriculture and engineering, the staff includes agriculturists, physicists and engineers, but from the nature of things the engineering side predominates.

The work of the Institute may be broadly divided into: Testing, research, education, and advice.

Testing.—Some testing work has already been conducted in the past, as the result of which reports have been published in this *Journal* and elsewhere. It is extremely probable that in the future testing work may be extended. At present the farmer has practically no opportunity of obtaining reliable and authentic information as to the capabilities of any machine or implement he may contemplate purchasing. It will be obvious that he will benefit by a clear statement of the performance of a machine under stated conditions, drawn up in such a form as to enable him to estimate how far the machine will be of service to him under his own particular conditions.

Research.—In the past empirical methods have largely prevailed in the design of agricultural machines and implements. It is contended that to obtain the greatest efficiency agricultural engineering should be placed on a scientific basis. Research in agricultural engineering may be considered to have a two-fold aspect. There is first of all pure research or the determination of the principles underlying the use of the various classes of agricultural machines and implements. Investigation of this nature usually proceeds without consideration of any possible practical applications of the findings. Afterwards there is applied research by means of which the principles determined by pure research are given practical application. Research work frequently arises out of tests of a whole class of machines or implements which are designed to perform an identical or similar agricultural function. Such tests as a rule lead to the determination of the general principles of mechanical and economic efficiency which should govern the design of any machine or implement intended for a particular task, but not infrequently there are left residual problems which demand further research.

Sub-soiling.—Let us take an example. There is an operation known as sub-soiling which is becoming well known to most arable farmers. There is nothing new about it. A hundred years ago it was probably practised extensively. The process consists essentially in disturbing the hard pan or solid stratum of earth often found below the normal depth of ploughing, but

of the soil. The reasons for success or failure were unknown, although a number of hypotheses were current. Two seasons ago therefore a large number of plots were ploughed and sub-soiled in typical Essex soils; in each section a control plot was placed from which to measure the yield from ploughing. Both the control and sub-soiled plots subsequently received identical treatment.

In the first year every sub-soiled plot produced a greater yield than the plots which were ploughed only. The yields from the same plots in the second year after sub-soiling are now becoming available and the sub-soiled plots again show superior yields. For the particular conditions which governed the work during these two years, sub-soiling has proved successful, and has far more than covered the original cost. On purely empirical grounds therefore it is possible to recommend sub-soiling in conditions similar to those where the plots were laid down. But much more work is necessary before the full effect of sub-soiling can be measured and still more before we can answer the question "why."

Research work is now being conducted therefore to discover the precise physical conditions produced by sub-soiling which cause this increased yield, and to determine the best mechanical means for producing these required physical conditions, having due regard of course to economic considerations.

Drying Crops.—Reference may also be made to an enquiry into methods of drying crops in the stack. This investigation is also in its second year. The object is to determine under what conditions crops which have not dried out in the field may be harvested and stacked and then dried. To effect this artificial drying the method employed by all experimenters for forty years or more has been to use a blast of atmospheric air delivered by a fan. If crops can be successfully treated in this way, considerable economy will result from the elimination of many of the harvesting operations subsequent to cutting, and the losses occasioned by bad weather will be avoided. The investigations have proceeded so far that it has been possible to devise a new system of employing heated air which, there is strong reason to believe, will not only dry crops successfully but will produce hay, for example, with a greater nutritive value than that made in the ordinary way.

It is unnecessary to enter into details now since it is hoped shortly to publish in this *Journal* a description of the exact methods employed together with a summary of the results

obtained. But it may be remarked that here again while a successful and practical process has been devised a number of problems are still left into which further work will take place.

Windmills.—Further work of some general interest is a test of windmills used for generating electricity. A site has been secured on which a number of these windmills have been erected, and records are being collected of the efficiency of the various types of mill under varying weather conditions, particularly in relation to the output of electricity. While the main object of the enquiry is to discover whether windmills can be designed to produce electricity more cheaply than other prime movers, at the same time the investigations include such matters as the efficiency of the windmill apart from its use as an electricity producer. There is reason to expect that the greater knowledge of aero-dynamics which now exists will make it possible to design vanes giving a higher efficiency than has hitherto been generally possible.

Drainage.—Finally mention may be made of drainage among the other subjects receiving attention at the Institute. Research work is in progress to obtain light on the underground movement of waters, as the result of which it is hoped to determine the precise drainage requirements in the way of drains for any particular set of conditions. In the case of mole drainage, for example, this should take the form of a prescription giving in relation to the diameter of mole, the depth and distance between drains which will produce the best results at the lowest cost. Similar information should be obtained with regard to other types of drains and combinations of different types.

These examples, which cover but a small part of an immense field of research embracing every agricultural operation in which machinery plays a part, will suffice to indicate the general trend of the research work of the Institute. Only a limited number of problems can be attacked simultaneously, and the great object must be to complete satisfactorily each piece of work as it is taken in turn.

Education.—It is generally agreed that the opportunities at present provided for farmers and students to obtain a knowledge of agricultural engineering are inadequate, and one of the great objects of the Institute is to raise the level of instruction. It cannot teach a great number directly, no more in fact than the undergraduate students taking an agricultural course at Oxford and a certain number of post-graduate students. But in training post-graduate students it can act as a centre from which

instruction can spread and by its methods and the results of its research work it can set a high standard of attainment. All possible assistance will at all times be rendered to those engaged in instructing agricultural students elsewhere. To the farmer also it can render immediate aid.

Advice.—The Institute counts as amongst its most important work the supply of information to farmers on agricultural engineering problems. It is gratifying to state that the services of the Institute are already greatly sought after. Care is being taken to collect information from every reliable source in order that the Institute may be well equipped to answer enquiries of all kinds. In dealing with enquiries and in giving advice, economic considerations are put first. The right machine, the right mechanical method, may lead to great savings or to great increases in production, while the wrong machine or wrong method means wasteful expenditure. On such points the farmer can be guided directly. Indirectly he may be led to a truer perception of the functions of engineering in agriculture.

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LIME BURNING ON A YORKSHIRE FARM.

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IN Yorkshire, possibly more than in most counties, the shortage of lime on much of the grass and arable land is one of the limiting factors to which attention must be given, if the fertility of the soil is to be maintained. It is not only on the soils naturally deficient in lime, like the Millstone Grit and Coal Measure soils, or in the industrial areas of the West Riding, in which the acid rainfall would tend still further to deplete the soil originally poor in this respect, that we find a high lime requirement. The prevalence of finger-and-toe in the roots, and of many of the indicator weeds. such as spurrey; the repeated failure of the barley crop and difficulty in getting a good take of seeds, frequently met with even on the Wolds, and on the soils overlying the chalk, mountain oolitic or magnesian limestone; all suggest that many of the soils actually overlying the limestone are themselves deficient in lime. Analysis of the soils in question only too frequently proves this supposition to be correct.

The frequency with which old and disused lime kilns and lime clamps are met with on many of the farms in the North and East Ridings, suggests that our ancestors at all events had

realised the importance of periodic applications of lime, even to soils overlying the chalk or limestone. With increasing costs of labour and falling prices of corn, most of these kilns or clamps fell into disuse, and very little lime has been burnt in them during the last forty years. Whether the time has now come when it would be an economic proposition for some of them to be used again, is an interesting speculation, to which a few at all events of the large arable farmers in these districts are giving careful consideration.

Of the 62 commercial farms at present being costed through the University of Leeds, one of the most interesting is Moor Farm, Seamer. It is a farm of just over 600 acres, overlying the corallian limestone, and is the most self-contained farm that I have met. In this connection it may be said that last year wood was required for fencing; timber on the estate was felled by the ordinary farm labour, a saw bench was set up to be worked by the farm tractor in the slack time, and the necessary rails and posts were cut, and even the farm gates made. The prepared material required creosoting: a concrete creosoting tank was therefore made and put down at a very low cost. An extra cart was required; it was made in the farm workshop by the ordinary hands. The horses want shoeing: they are shod on the premises, on which a farm forge has been established. An elevator was required for stacking corn and hay: it was built by the farm workmen under the skilled supervision of Mr. Webster and the farm joiner. If there is a shortage of farmyard manure an excellent substitute can be obtained from fish refuse bought cheaply in Scarborough and stored in a disused pond: and by the aid of this, excellent crops of roots are grown at a cost of £12 14s. 4d. per acre or 10s. 6d. per ton. Some hundred or more pigs are usually on the premises, and when the dry-feed system was adopted, the necessary dry feeders were made by the home labour from timber, felled, sawn and creosoted on the premises.

When, therefore, there was noticed signs of shortage of lime, and on sampling some of the soil it was found to have a lime requirement of over 30 cwt. to the acre, it was only natural that Mr. Webster should turn his attention to two old disused lime-kilns on the farm, and consider the feasibility of converting them into a lime clamp.

The Clamp.—The clamp was ideally situated, cut in the side of the hill, with the open face of the quarry behind; so that there was a good lead out for the burnt lime, and little

difficulty in filling it. The stone itself was an excellent sample of oolitic limestone, containing over 97 per cent. of calcium carbonate. Realising the importance of filling and firing the clamp properly, Mr. Webster was fortunate in securing from the neighbouring village of Snainton, the assistance of an old and skilled workman, who had had experience in what was fast becoming a lost art.

The clamp itself was 36 ft. long, 12 ft. wide at the base as originally set out, but with the side now burnt away to an irregular width of approximately 15 ft., and is 12 ft. deep.

Building the Clamp.—In building a clamp great care must be taken to get a sufficient through draught for ventilation purposes, and it was interesting to see the special precautions taken to ensure complete combustion of the limestone, as if the clamp fails to burn right through, it may be necessary to empty and rebuild it. The side walls which had burnt away irregularly were first built up squarely to prevent any eddying currents or pockets. The bottom layer was formed of irregularly-shaped stones 4 to 6 in. thick, and 8 to 9 in. wide; with an intervening air space of approximately 6 in. These were covered with thinner flat stones, again not quite touching, but leaving air spaces between. A series of 10 or 12 small tunnels thus runs the whole length of the clamp, being connected with two chimney flues at the north-west and north-east angles.

These flues were built up of flat stones laid on edge, built up as each layer was put in the clamp, and leaving a triangular air space, whose sides were roughly 3 ft. In order to ensure this being kept open, two sacks filled with straw were placed in the position of the flues, and gradually pulled upwards as the building of the various courses of the clamp proceeded.

On the top of the flat stones covering the bottom layer, was laid about 3 in. of dry straw, over this a layer of brushwood and larger sticks to a depth of about a foot, at the top of which was the first layer of small coal, some 3-4 in. in depth.

From now upwards, alternate courses of limestone and coal were laid, the thickness of the limestone increasing from 8 in. in the bottom course to 12 in. in the second and then up to 18 in. nearer the top, where the heat rises and gets more intense. The bottom course, 8 in. thick, was formed of smaller stones 4-6 in. thick with an air space between, similar to those in the bottom layer of the clamp. Two eye holes 2 ft. 6 in. high by from 9-12 in. wide, were left in the front wall for firing the clamp when ready.

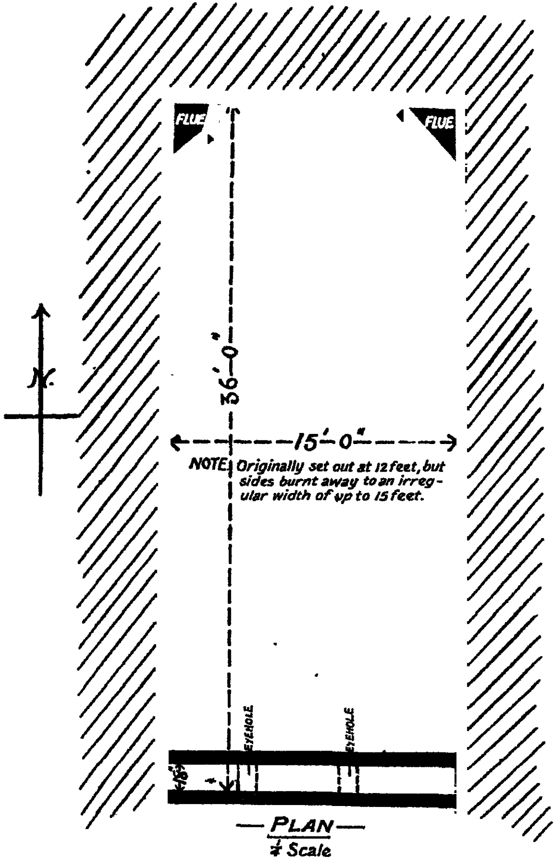

FIG. 1.—Plan of Clamp.

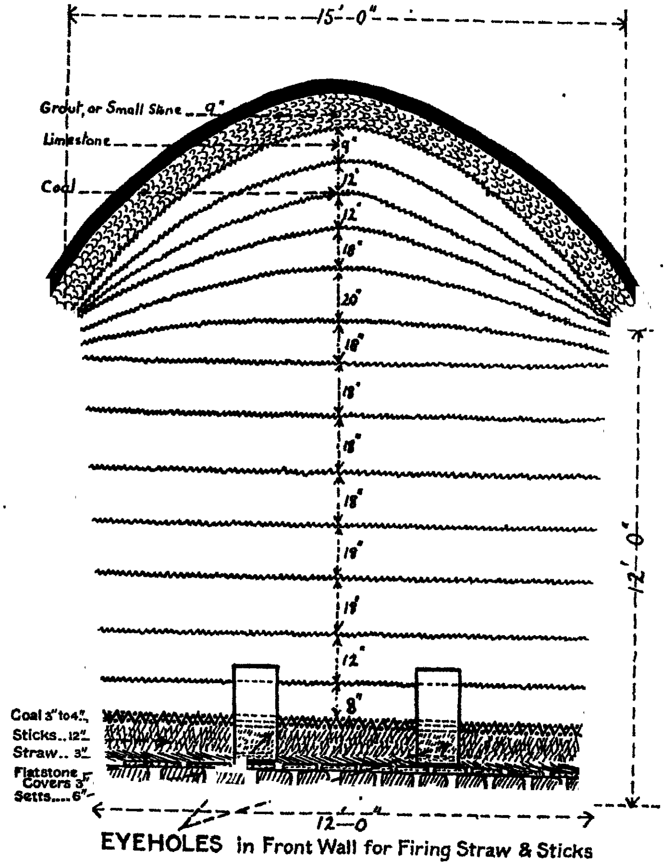

FIG. 2.—Section of Clamp.

As each layer of limestone was laid, small coal and slack were spread evenly over it and worked into the interstices, the sharp points of the stone just showing through. There was thus no measurable thickness of coal, except in the case of the first layer immediately over the sticks, which, as already mentioned, was 3-4 in. deep. The limestone for the layers was broken into pieces 2-6 in. wide, and spread level, except towards the top where it was gradually heaped up into the middle. Very small limestone or "grout," some of it almost limestone dust, was used for the final covering of the clamp. This was put on in a moist condition, to a depth of roughly 12 in.

The front wall of the clamp was built up of flat stones, laid dry, with small stone or grout worked in to prevent strong winds blowing through. As there would be a danger of the great heat developed during the burning of the clamp forcing out the front wall, "through stones" were left, under which strong wooden props were placed to prevent bulging.

During the filling of the clamp, which occupied a week, stack covers were always in readiness, so that it could be kept dry in the event of rain; similar precautions were taken in the case of the brushwood and sticks used for starting the clamp. When all was finally ready, the two sacks of straw were removed from the top of the flue, and the clamp was fired by means of a few shovelfuls of red hot coals placed in the eyeholes. At the time, a strong south-west wind was blowing, and as there was a danger of the straw and sticks burning out before the coal had got properly alight, a load of straw was so placed as to break the full force of the wind.

Results in 1922.—In 1922 the clamp was filled in September, immediately after harvest, and fired in November. Thirty-two tons of coal were used, and 156 loads of 23 cwt. of quicklime, or approximately 180 tons, were led out of the clamp. One ton of coal, therefore, was required for every 5½ tons of burnt lime, or for each ton of quicklime obtained, 3½ cwt. of coal was burnt.

The labour sheets showed that—(*a*) 5 men were employed a full week in quarrying the limestone; (*b*) 10 men and 2 carts were engaged for five days in breaking the stone and filling the clamp; and (*c*) 1 man was in occasional attendance at the clamp for 10 days during the burning.

Charging the horse labour at 4s. 4d. per working day (the actual cost as determined by the investigation of the whole year's accounts), and the man labour at the price actually paid, the cost of the burnt lime in the clamp can readily be determined.

Cost of 180 tons of Burnt Lime in the Clamp.

	Man Labour.				Horse Labour.				TOTAL.		
	Days.	£	s	d.	Days.	£	s.	d.	£.	s.	d.
Quarrying	27½	9	0	10	—		—		9	0	10
Breaking stone and filling clamp	50	14	14	6	10	2	3	4	16	17	10
Burning	10	3	10	0	—		—		3	10	0
Coal, including cost of haulage	—		—		—		—		70	12	6
TOTAL COST ...	87½	£27	5	4	10	£2	3	4	£100	1	2
Cost per ton of burnt Lime	0.49	0	3	1	0.06	0	0	2½	0	11	2

Cost per Ton.

	£	s.	d.	Percentage.
Quarrying	0	1	0	9
Breaking stones and filling clamp	0	1	10	16
Burning	0	0	5½	4
TOTAL LABOUR	£0	3	3½	29
Coal 3½ cwt.	0	7	10½	71
TOTAL COST	£0	11	2	100

It will be seen, therefore, that in the year 1922 quicklime was obtained on the farm in the clamp at a cost of 11s. 2d. per ton, to which cost labour contributed 29 per cent., and coal contributed 71 per cent.

Results in the Three Years 1921-3.—As the clamp has now been made use of for three successive years, and full details of the working costs are available for 1921, 1922 and 1923, some idea may be obtained as to how far the 1922 results may be looked upon as typical.

	1921.			1922.			1923.		
	£	s.	d.	£	s.	d.	£	s.	d.
Quarrying	8	11	7	9	0	10	12	9	10
Breaking stones, filling clamp and burning	38	3	8	20	7	10	25	10	0
TOTAL LABOUR ...	£46	15	3	£29	8	8	£37	19	10
Coal	68	10	0	70	12	6	56	8	10
TOTAL COST ...	£115	5	3	£100	1	2	£94	8	8
No. of tons of quicklime obtained	172			180			184		
Cost per ton of quicklime	£0	13	4	£0	11	2	£0	10	3
Weight of coal used per ton of quicklime	3.8 cwt.			3.5 cwt.			3.4 cwt.		

It will be noticed that the 1921 and 1922 costs of quarrying the stone were practically identical, but that there was a big increase in this figure for 1923. This was due to the fact that owing to an error in judgment, much more stone was quarried than

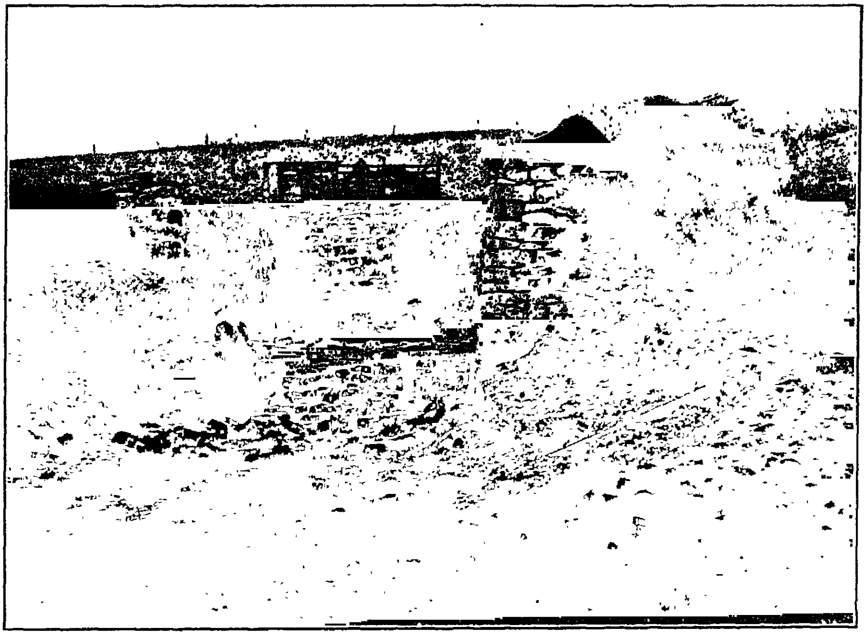

FIG. 3.—Front view of Clamp, showing side walls irregularly burnt away, two eyeholes left for firing the Clamp, and arrangements for ventilation.

FIG. 4.—Front Wall of Clamp.

FIG. 5.—Nearing the top of the Clamp, showing two flues protected by sacks of straw, and alternate layers of limestone and coal.

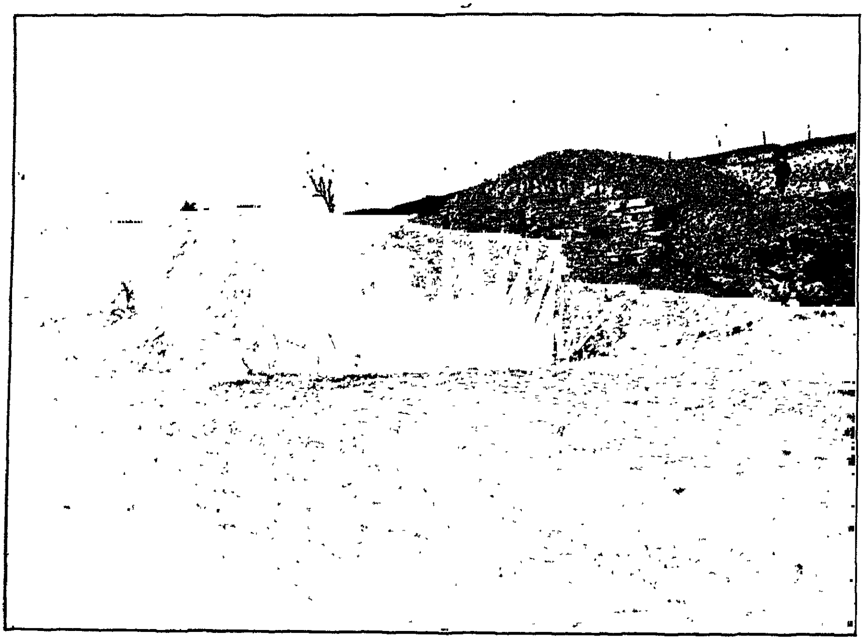

FIG. 6.—Clamp filled ready for firing. Front wall propped to prevent bulging; load of straw placed near to break force of S.W. wind.

could be got into the clamp, and at least 40 loads have been left over to be burnt in 1924.

The labour costs for filling and burning the clamp were particularly high in 1921. This was due to the fact that a difficulty was experienced in getting the clamp to burn satisfactorily—a difficulty only got over by finally rebuilding and taking the precautions which have already been described in detail. It is interesting to note that even under these conditions, the quicklime was obtained at a cost of 13s. 4d. per ton.

The lower cost of the coal in 1923 was due to the fall in the price of coal rather than to the fact that less coal was burnt per unit of quicklime obtained.

Apparently on this farm, the cost of the quicklime obtained will be a variant dependant upon (*a*) the wages paid to the men, (*b*) the cost of horse labour, and (*c*) the cost of coal on the farm, and for any year an estimate of the cost per ton could quickly be obtained by taking the sum of (1) half the average daily wage of the men employed, (2) one penny in the shilling of the estimated cost of horse labour per working day, and (3) the cost of 3½ cwt. of coal on the farm.

Thus, in the old days when the farm labourer was getting little more than 2s. a day, when horse labour was costing certainly not more than 2s. 6d. per working day, and coal could have been got at less than £1 a ton, quicklime should have been obtained on the farm at approximately 4s. 6d. per ton, at which price it would certainly have been a paying proposition to keep busy the various clamps and kilns one meets with on the farms up and down the country.

With the increasing cost of labour and falling price of corn, lime burning fell out of favour on the farm. Now that there are more hopeful signs of cereal crops again becoming more reasonably profitable, the feasibility of re-opening some of these clamps and kilns, particularly in the barley areas, must be considered. This is all the more desirable when it is realised that at the present time it is possible by these means to obtain quicklime on the farm at a cost of little more than 10s. per ton—a figure which compares favourably with an average cost of from 30s. to 35s. per ton delivered on the farm when purchased in the ordinary course.

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THE MAINTENANCE OF ARABLE CULTIVATION IN SCOTLAND.

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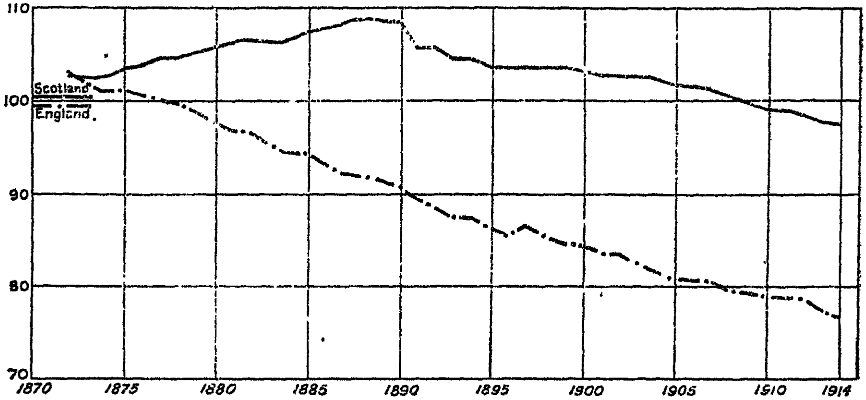
THE maintenance of the arable area in Britain is a problem that has given rise to much discussion. Involved in it is the whole question of production *versus* profit—whether the national need for greater output from the land can be reconciled with the requirements of the industry as to wages and profits; or whether these can only be maintained in times of low prices by a reduction of effort and of expenditure. It is here proposed to discuss one aspect of the problem.

It is generally conceded that during the past fifty years agriculture in Scotland has contrived to yield fair wages to its workers and a margin of profit to its farmers. In this period the industry in England has experienced severe depression. At the same time the agricultural statistics show that the decline in the area described as arable land has proceeded differently in Scotland as compared with England. Indeed, in Scotland the amount of plough-land increased steadily by nearly 8 per cent. during the first two decades of the past fifty years. It was not until the early 'nineties that a downward tendency was manifested, and by 1908 the area was reduced to the amount at which it stood in 1870. In marked contrast with this, there was a steady decline in the area of English plough-land of about 5 per cent. on the average in each decade from 1870 to 1914 (see Fig. 1).

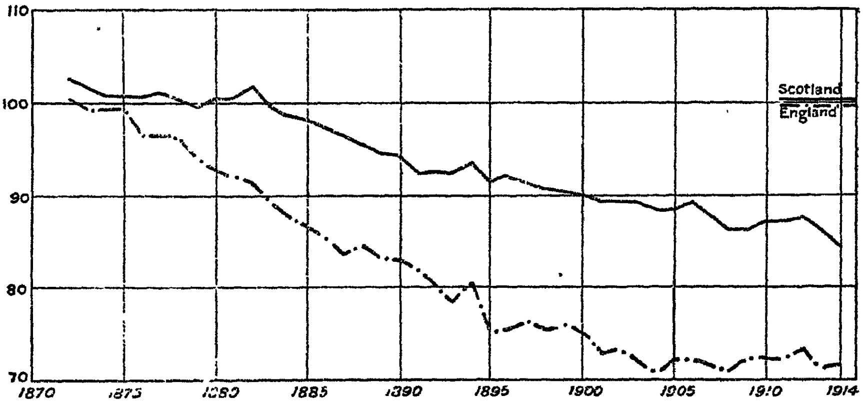
Corn Crops.—It is necessary now to examine these facts. In England, that part of the arable area devoted to corn crops showed no decided change until 1875, after which the fall was rapid and continuous up to 1904. Thereafter the area remained fairly constant. Scotland, on the other hand, succeeded in maintaining its area under corn crops until 1882, after which a steady fall set in and continued until 1914. Taking the whole period, England's area under cereals fell 28 per cent., and Scotland's fell 15 per cent. (see Fig. 2). One fact, therefore, stands out at once—Scotland did not maintain her arable area by means of corn growing.

Rotation Grasses.—Turning now to the annual variations in rotation grasses and clovers during the fifty-year period (Fig. 3), it appears that the English figure kept well above the average used for the datum line (*i.e.*, the average of the three years, 1867-70) until 1909, rising as much as 21.1 per cent. above



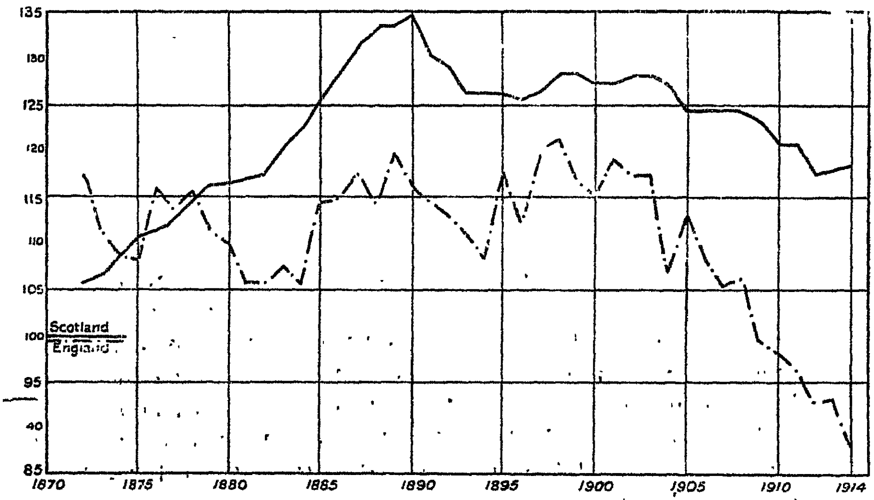
Base - Average Arable Acreage 1867-70. {For England 13,431,000 acres = 100 / " Scotland 3,384,000 " = 100}

FIG. 1.—Total Arable Area, showing percentage annual variation.



Base - Average Area of Corn Crops 1867-70 {For England 7,563,000 acres = 100 / " Scotland 1,398,000 " = 100}

FIG. 2.—Area under Corn Crops, showing percentage annual variation.



Base:- Average Area of Rotation Grasses 1867-70 {For England 2,405,000 acres = 100 / " Scotland 1,249,000 " = 100}

FIG. 3.—Area under Rotation Grasses and Clovers, showing percentage annual variation.

it in 1898; in 1908 it fell below it; and continued to fall rapidly until 1914. The Scottish figures show a movement distinctly different. There was a steady rise up to the year 1890, amounting in that year, which is the maximum, to nearly 35 per cent. above the datum. The next three years show a sudden drop, followed by a fifteen-year period (1894-1908) of comparative stability, after which the fall is continued up to the commencement of the War. Even then, in 1914, the percentage of rotation grasses and clovers was 18.6 per cent. above the 1867-70 datum.

A feature of the variation lines as plotted is the regularity of the Scottish line in comparison with that for England, which shows marked divergencies almost from year to year. The explanation of this is, probably, the practice of long leys in Scotland as against a preference for one-year leys in England.

Other Crops.—With regard to the "other crops" which make up the rest of the arable land, the two countries are in almost complete accord. The statistics for both countries show an almost continuous fall throughout the period, greater in Scotland in the earlier years (1872-87) and in England in the later years (1896-1914).

Both countries, therefore, shared a very similar fate as regards corn crops and "other crops." It is to the greater use of rotation grasses and clovers (as shown by Fig. 3) that Scotland owes the maintenance of its area of land under arable cultivation. Actually, Fig. 3 does not bring out the full significance of the situation, in that it takes no account of the fact that, while in the years 1867-70 (the datum) the area under rotation grass in Scotland was 36.9 per cent. of the total arable area, in England rotation grass only occupied 17.9 per cent. of the total arable area. It is obvious that a 10 per cent. increase in rotation grass would exercise a greater influence upon the total in the former country than in the latter.

Permanent *v.* **Rotation Grass.**—It is now necessary to consider the relative position of the grassland in each country. The changes in the arable areas are only approximately the measure of those in the grass areas, owing to fluctuations in the total cultivated area. Thus, in Scotland both arable and grassland increased up to the year 1890, and only after that date was the increase in the grass area obtained at the expense of the plough-land. In England, the decline in the arable land having been continuous almost from the start, the effect of fluctuations in the total cultivated area is less apparent.

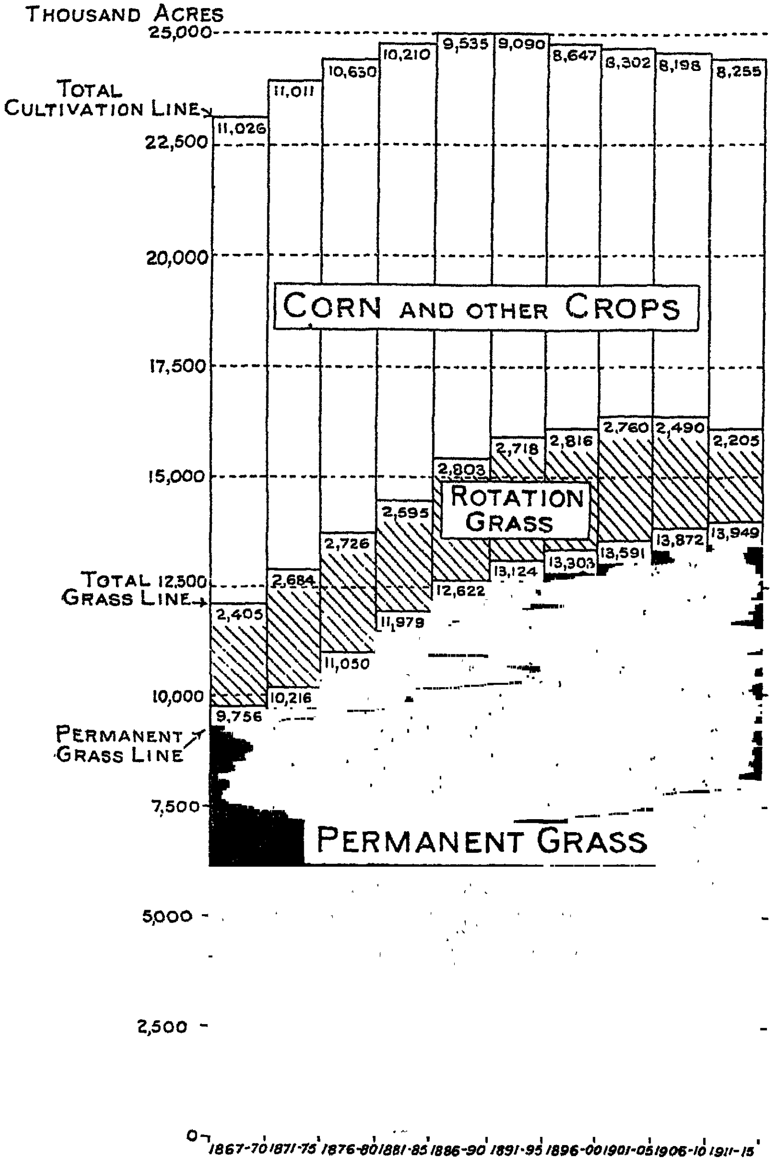


FIG. 4.—Distribution of Cultivated Area: England.

In Figs. 4 and 5 the changes in the extent of the permanent grassland in England and Scotland respectively are illustrated in solid black. The two facts that are obvious are, first, that in England the proportion of permanent grass to arable has always been much higher than it has been in Scotland. and,

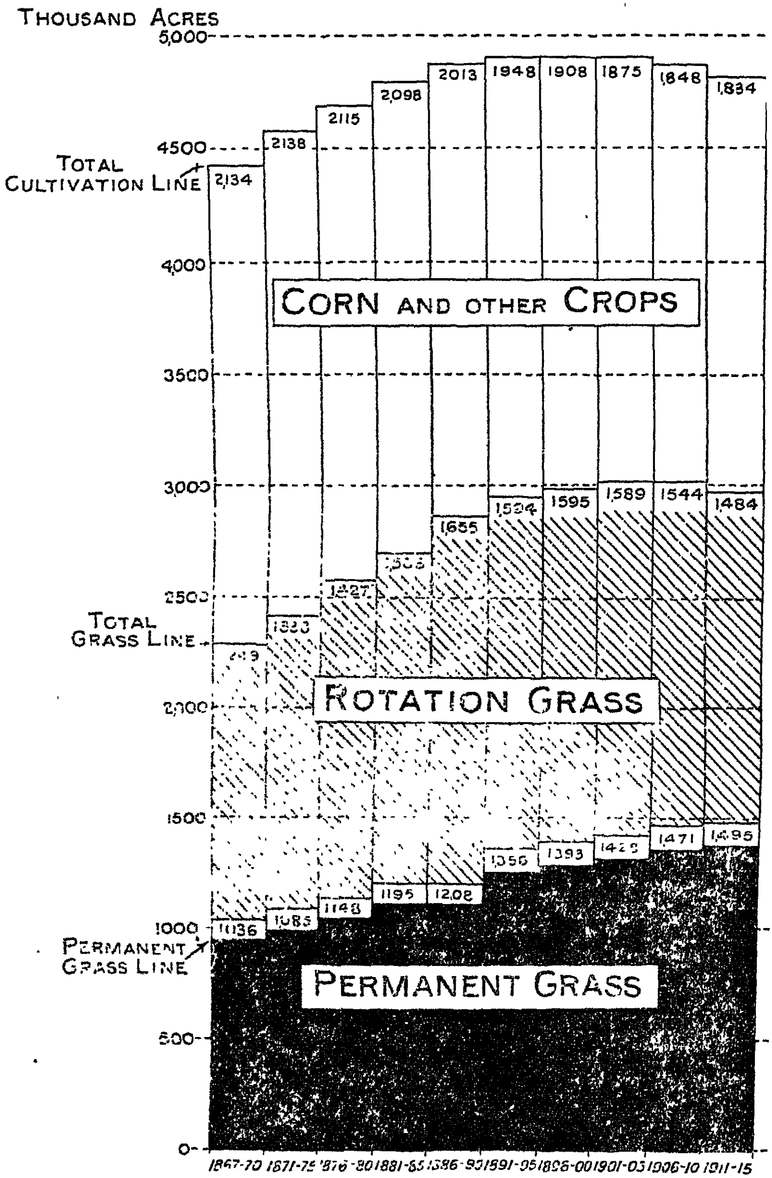


FIG. 5.—Distribution of Cultivated Area : Scotland.

second, that in the former country the rate of increase of permanent grass has been much greater than in the latter, this being the corollary to the position shown in Fig. 1.

If, however, the areas under rotation grasses in each country be added to the areas under permanent grass, the position is entirely changed, and we find that taking " All Grass " as the

basis of comparison the situation in the two countries is practically identical :—

Proportion of Grassland to Total Cultivated Area in England and Scotland.

	Permanent Grass only		All Grass (Permanent and Rotation)	
Average for period :—	1867-70	1911-15	1867-70	1911-15
	per cent.	per cent.	per cent.	per cent.
England	42	57	52	66
Scotland	23	31	52	62

It is obvious at once that the bald statement that Scotland has maintained her arable area during the long years of the agricultural depression whilst England was laying land away to grass requires considerable qualification, and that what really happened was that both countries embarked upon an active grassland policy dictated by the changes in the economic conditions of world agriculture, which brought, ultimately, the proportion of land under corn and other crops to grassland in each of them approximately to the same point. But whilst farmers in England resorted to permanent grass their fellows in Scotland pursued the practice of long temporary leys, which, since they are broken up at intervals of varying lengths, and put under a rotation of crops, appear in the statistics under the classification of "arable land."

The causes and effects of these different national developments afford material for an important study. It is not the purpose of this note to pursue it. The difference may be due to climate, or to national temperament. It has been asserted that permanent grass is much more easy to establish in England than in most parts of Scotland. On the other hand, the Scottish farmer has the reputation of being more cautious, and the leaving of rotation grass in longer ley is a less drastic policy than laying down permanently to grass.

The effects require much fuller investigation. The rotation grass system is obviously more elastic than permanent grass. A rise in the price of corn can be quickly turned to advantage where the grass is only temporary, whereas to break up good permanent pasture for the sake of what may be only a transient betterment in prices, would be a gamble. Further, rotation grass is more productive as a general rule than permanent. On the other hand, if the end and aim of the farmer is to reduce costs to the minimum, it is apparent that rotation grass is less valuable than permanent pasture.

In the face of a growing national concern for the welfare of agriculture and rural population an investigation of the economics of these two systems of farming seems to be overdue.

SUGAR BEET PULP AND SLICES.

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BEFORE discussing the feeding values of wet or dried sugar beet slices or pulp, it will be of interest if a brief outline is given as to the nature and origin of what promises to be a very extensively used feeding stuff.

The terms sugar beet slices or sugar beet pulp, refer to one and the same material, namely, the residual slices or pulp after the extraction of the bulk of the sugar from the beet. When the sugar beet is delivered at the factory it is tipped into huge open channels called flumes, about 100 ft. long by 20-30 ft. broad and 15 ft. or more deep, having sloping sides which meet at the base to form a deep and narrow gutter or open channel. Water is allowed to flow through this open channel at will, thereby floating the beet directly into the factory.

The beets are then elevated into revolving washing tanks and from there they are again carried by means of elevators to an automatic weighing machine situated on the top floor. As soon as a certain weight of beets is reached the iron basket tilts automatically and its contents fall into cutting or slicing machines, which revolve at a great rate, and cut the beets into slices of regular shape—about 3 to 4 in. long by $\frac{1}{8}$ in. in diameter.

These slices are then conveyed to the diffusion battery, which consists of a number of iron cylindrical diffusers holding 5 or more tons of slices and fitted with valves to regulate the supply of hot juice and water, and also moveable caps at top and base for filling and emptying.

The hot juice and water is forced by pressure through the series of diffusers, extracting the sugar from the beet on the way. When the process is complete the juice or sweetened liquor is pumped through for purification treatment and the residual slices or pulp are removed by opening the bottom cap. In this condition they are known as wet pulp. Before being offered to local farmers they are generally put through pressers to reduce the volume of water, but even then the amount of water retained is too much to allow their economic use by farmers situated at a distance, as this would necessitate carriage charges. To overcome this difficulty modern factories are equipped with a drying apparatus, and after treatment the slices contain a very small proportion of water and are in fact just like dried "chips."

When in this condition they are bagged ready for despatch, and can be kept with safety for any reasonable time if stored in a suitable and dry place.

Wet Pulp or Slices.—The pressed wet pulp varies in its water content from about 90 to 93 per cent., thus containing rather less dry matter than mangolds and about the same as ordinary root crops. It also contains about the same quantity of carbohydrates as common turnips and rather less than mangolds, but whereas 5 to 6 per cent. of the starchy matter in the case of mangolds is in the form of sugar, only about 0.5 per cent. will be sugar in the case of beet pulp. The remaining carbohydrates are, however, largely available or digestible, and have a distinct feeding value. Farmers who live within carting distance of a factory will find it an economical proposition to load in with sugar beet and load out with wet pulp, subject, of course, to price and water content.

On the Continent it is usual to convert the wet pressed pulp into silage, by putting it into clamps or pits and occasionally in alternate layers of 2 ft. to 3 ft. with the leaves and tops, the whole being consolidated by drawing the loaded carts over the clamp and emptying as they pass over. The clamp is then covered with soil to a depth of from one to two feet, and if it is properly made the silage can be kept for two years or even longer, or it can be opened and used after two or three months. In both cases it is usual to ventilate the clamps for a time along the ridge, as with mangolds, and also to allow the drainage water to escape, as otherwise decomposition will set in.

In years of high yield, it is quite a common practice to make more silage than is actually required, and to keep some clamps over to guard against a year of small crops and consequent small yields of pulp for stock feeding. In the sugar beet areas of Germany no other root stuff besides beet pulp is used for feeding cattle, but in Holland and France mangolds are often fed in conjunction with the pulp.

Dried Slices or Pulp.—Dried pulp, as before stated, simply consists of the wet pulp that has undergone a drying process, thereby reducing the water content from about 90 per cent. to about 8-11 per cent. according to the method used.

The sugar content varies according to whether the diffusion process or the Steffen process has been used in the extraction of sugar, but the former method is far more common and will probably be generally adopted in this country. Dried slices obtained from the diffusion method contain about 60 per cent.

of carbohydrates, of which 4-5 per cent. may be sugar, whereas with the Steffen process there may be 68 per cent. of carbohydrates. of which 30-35 per cent. may be sugar, but as the diffusion process is almost solely followed it will be understood that it is diffusion pulp that will be referred to when dealing with rations for livestock in this article. The carbohydrate matter is of a very available or digestible nature as will be seen from the tables of analyses given below.

Dried slices have a very definite value as a feeding stuff for stock, making an excellent substitute for roots, being palatable, succulent and bulky, while it can be stored in a suitable place for any length of time, is easy to handle and use, and requires no cleaning or preparation as with roots.

The dried pulp when mixed with about twice its own weight of water quickly becomes a bulky mass which can be mixed with "chop" in the same way as pulped roots. It will therefore be easily understood that a ton of dried pulp will make an equivalent to several tons of mangolds or other root-crop containing somewhere about nine-tenths of its total weight of water, and which incidentally must be handled and carted from the field to the clamp and again to the food preparing and mixing floor.

Comparative Analyses of average composition per cent.

(From *Rations for Live Stock*, by Professor T. B. Wood, C.B.E., M.A.: Ministry of Agriculture Miscellaneous Publication No. 32.*)

	Common Turnip.	Intermediate Mangolds.	Wet Pressed Pulp.	Dry Pulp.	Sugar beet tops as Silage.
Dry matter ...	8.5	12.0	7.0	88.8	23.0
Protein ...	1.0	1.0	0.6	8.1	2.4
Oil	0.2	0.1	—	0.6	0.7
Carbohydrates	5.7	9.4	4.7	58.5	9.1
Fibre ...	0.9	0.7	1.4	17.6	3.4
Ash	0.7	0.8	0.3	4.0	7.4

Wet pressed pulp varies according to method and amount of pressure used, and may contain as much as 10 per cent. of carbohydrates. The Kelham Factory pulp contained 8.5 per cent. of dry matter.

The net digestible energy as starch figures per cent. are as follows: Common turnip, 4.4; mangolds, 6.2; wet pulp, 5.0; dried pulp, 51.0; sugar beet tops, 9.5.

Feeding Sugar Beet Pulp.—Kellner stated that beet pulp, either fresh or made into silage, gives very good results with fatting bullocks and dairy stock, the quantities fed being 60 to 80 lb. per 1,000 lb. live weight for the former and about half as much for the latter class of stock. For dried pulp he ad-

* To be obtained from the Ministry's office, 10, Whitehall Place, price 6d., post free.

vocated the use of 10 to 15 lb. per head for fattening bullocks, 6 to 10 lb. for cows, 4 to 6 lb. for horses, and 3 to 4 lb. for fattening pigs.

The writer recalls a farm in Germany where 200 cows in milk were kept and the basal and bulky part of the ration was 8 lb. of dried sugar beet pulp, 8 lb. of beet silage, and 8 lb. of straw, together with cotton meal and bran. The working farm horses got 1 to 2 lb. of dried pulp, together with ordinary corn and hay rations, and sheep were getting ¼ lb. dried pulp and 5 lb. of beet silage in addition to a mixture of five other grain and cake foodstuffs.

Sugar beet pulp is essentially a food rich in carbohydrates, *i.e.*, heat- and fat-forming constituents—of a highly digestible character, but it is low in proteins, which are necessary for forming lean meat and muscle and also in the production of milk. Further, pulp is poor in bone-forming minerals such as lime and phosphates. It is therefore necessary to include concentrated foods and fodder in a ration as with roots, and it is not advisable to feed large quantities to young stock.

Wet pulp has been stated to be harmful to pregnant animals when fed in large quantities, but the chief danger lies in feeding wet pulp that has been allowed to ferment or decompose, and serious trouble has undoubtedly been experienced from this cause. When feeding dried pulp in a mixture to sheep small quantities only must be used, as it swells considerably when inside the animal and might cause serious illness.

The pulp is a useful food for pigs and poultry, but it should be used as a substitute for roots or similar foodstuffs, and should be fed in small quantities in the wet or soaked state.

Experiment with Fatting Bullocks.—An interesting feeding trial was carried out in Norfolk in 1912 under the direction of Professor T. B. Wood, in collaboration with the writer of this article. The slices used were imported from the Continent, and were found to have the following analysis :—

	Per cent.		*Per cent.*
Water	9.5	Fibre	15.3
Crude proteins ...	10.6 (A)	Ash	2.8
Carbohydrates ...	61.8 (B)		
			100.0

(A) Containing 1.7 per cent. nitrogen.
(B) Including 7 per cent. sugar.

The slices contained, therefore, 90.5 per cent. of dry matter. The roots with which they were compared were swedes in the

early part of the experiment, and mangolds at the finish. They contained on the average just over 11 per cent. of dry matter—that is to say, one-eighth of the amount contained in the slices. The rations used aimed at giving equal weights of dry matter in slices and roots; consequently 1 stone of slices was used for each 1 cwt. of roots.

The experiment lasted from 8th January to 18th March, a period of ten weeks. The rations consisted of 2 lb. undecorticated cotton cake, 2 lb. linseed cake, and as much chaff as the bullocks would eat. Ten bullocks received, in addition, 1 cwt. of roots; while the second batch of ten received 1 stone of slices, which were moistened some hours before being fed to the bullocks with about twice their weight of water, 14 lb. of slices requiring about 2 gallons.

During the first month of the experiment whilst the "roots" bullocks were on swedes, the "slices" bullocks made the greater increase in weight—20 lb. per head per week, as compared with 16 lb. per head per week. This was to be expected, as the swedes contained only 9 per cent. of dry matter, and 1 cwt. would correspond to about 11 lb. of slices. During the latter part of the experiment, whilst the "roots" bullocks were on mangolds, containing 12 per cent. of dry matter, they gained weight rather more rapidly than those on slices. This, again, was to be expected, for 1 cwt. of mangolds, containing 12 per cent. of dry matter, should correspond to 16 lb. of slices, whereas 14 lb. only were fed.

On the average of the whole period the weekly gains per head were practically the same—13.6 lb. per head per week on slices, 13.1 lb. per head per week on roots. The bullocks throve well throughout the experiment.

Prospective users of slices may take it that slices are good food for fattening cattle as a substitute for roots, and that 1 stone of ordinary slices of the composition quoted above is just about equivalent to 1 cwt. of ordinary mangolds, and rather better than 1 cwt. of swedes.

In another experiment carried out at the South Eastern Agricultural College very similar results and conclusions were arrived at, and it was noted that the animals killed well, giving meat of excellent quality.

Experiments with Milking Cows.—Series of tests were carried out in 1911 and 1912 at several agricultural colleges and the conclusions drawn were that dried sugar beet pulp provided a useful substitute for mangolds when fed in the proportion of 1 lb. of pulp to 8 lb. of mangolds.

The report of a trial carried out at the Royal Agricultural College, Cirencester, brings out some interesting points that may be repeated with advantage.

(1) As regards the effect of the two rations on the quantity of milk produced it is to be noticed that the yield of lot A (mangolds) remained constant. while in the case of lot B (pulp) there was a slight fall in yield during the period of the experiment.

(2) The quality of the milk seemed to be little affected by the change of food, as shown by the percentage of butter-fat. A slight increase, if anything, was noticed in the morning's milk in each case, and a corresponding decrease in the quality of the evening's milk.

(3) The butter produced from the cream of lot A was normal in texture, and yielded well, as shown by the butter ratio; but it was very pale in colour. The butter from the milk of lot B, on the other hand, was hard and more difficult to work, and had to be churned at a higher temperature in consequence; the colour, however, was much better than that from lot A.

(4) Referring to the general health of the cows during the trial, the dried slices at first seemed to have a laxative effect till the animals settled to their feed.

It is well known that when feeding large quantities of pulp to dairy cows, the resulting butter may be of a hard white appearance and poor in flavour.

This result can, however, be largely overcome by judicious use of the pulp together with a suitable proportion of concentrated feeding stuffs.

Experiment on Dairy Cows in Notts.—In 1922 an extensive series of tests was carried out by the Notts Education Committee under the supervision of the writer. Four herds of cows situated in different parts of the county participated, and at each centre the cows were divided into two lots, each being as near alike as regards age, yield and period of lactation. **Both lots received** approximately the same ration of foods other than dried beet pulp or mangolds, except that due allowance was made for the superior quality of the slices over mangolds as regards protein and starch equivalent. All the herds were on Milk Recording Farms, so that daily yields were carefully recorded before, during and after the period of the trials. Butter fat tests were made at all centres and careful calculations worked out as regards costs of all foodstuffs and milk sold.

The dried pulp, which was obtained from the Kelham Factory, gave an analysis very similar to that already given in the

preceding table. It was fed in different proportions at each centre, varying in the proportion of 1 lb. of dried pulp to 6, 7 and 8 lb. of mangolds.

The general conclusions arrived at over the whole series of trials were as folllows :—

(1) For the production of milk the best proportion was 1 lb. of dried pulp to take the place of 7 lb. of mangolds in the ration.

(2) It was possible to slightly reduce the quantity of concentrates in the dried pulp ration to bring to a similar feeding value to the mangold ration.

(3) The cows took to the dried pulp ration quite readily.

(4) The milk yield was slightly in favour of the dried slices ration.

(5) The fat content and quality of milk remained constant for both groups.

(6) The condition of the cows fed on the dried pulp was quite satisfactory in all cases.

(7) The pulp had a slightly laxative effect as with mangolds.

Market Value of Pulp.—The wet pressed pulp can be bought at the Kelham Factory by growers delivering sugar beet at 5s. per ton. This pulp contains about 8.5 per cent. of dry matter and has a nutrition value which is rather better than common turnips and not quite so good as mangolds. Taking the starch equivalent method as a basis for comparison we get the following weight in lb. energy as starch per 100 lb. of the feeding stuff. Wet pressed pulp, 5; common turnips, 4.4; swedes, 7.3; intermediate mangolds, 6.2. In practice about 50 lb. of wet pressed pulp is equivalent to 40 lb. mangolds.

It will be seen therefore that farmers within carting distance of a factory have access to a valuable substitute for roots at a very reasonable figure and the question of storing pulp in trench pits and converting it into silage should receive serious consideration. As before stated it can be fed fresh and forms a useful feeding stuff for all classes of stock on the farm. The dried pulp can be considered in a like manner, but prices quoted are f.o.r. or at factory and, therefore, rail or other transport charges must be added, although when comparing them with roots the cost of carting, storing, cleaning and chopping or pulping the latter can probably often off-set the transport charges on the pulp.

At the time of writing the price per ton for this season is not yet fixed, but last year it was on offer at £5 15s. per ton, and

growers could take 5 per cent. of the weight of beets delivered at £5 8s. per ton.

These prices rose sharply as the season advanced and in the early part of this year dried pulp was realising over £7 a ton f.o.r. Dried pulp contains from 7 to 8 times as much digestible dry matter as mangolds, and as shown by the experimental results stated herein, 1 lb. of dried pulp will go as far as 7 to 8 lb. mangolds, or in other words 1 ton of dried pulp is worth as much as 7 to 8 tons of mangolds.

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DAY COURSES IN AGRICULTURE FOR COUNTRYWOMEN.

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WOMEN have a big stake in the industry of agriculture, though the importance of their direct and indirect interest is insufficiently appreciated. The returns for 1923 (a year when conditions had returned more or less to normal, after the temporary expansion during the war) showed that 59,000 women and girls were in regular work on the land, while 43,000 were casually employed. There are, too, a number of women in business on their own account as farmers and market gardeners, and there are others engaged in agricultural instruction. The number of women directly engaged in agriculture is therefore considerable, even when compared with the employment of women in what are generally regarded as women's trades. As regards indirect interests, there is hardly any calling in which the women of the household are more intimately associated with the daily work of its head than in agriculture. It has been well and truly said that "the home life of the farmhouse and farm cottage, which is mainly the direct result of the activities of women, reacts upon the general efficiency and well-being of the farm to an extent which is not usual in the case of the home life of persons occupied in other large industries," and that "a prosperous agricultural community can never be established until the women of the farms are able to take their due part in the consideration and treatment of all the influences which affect its business and life."

Bearing these facts in mind, and remembering that rural depopulation has probably largely come about through the

dissatisfaction of the women with prevailing conditions, which has led them to persuade the men to migrate, it is natural to inquire whether in the agricultural education offered to women to-day, there are any developments of interest to chronicle. In other words, are there any modifications in the more elementary forms of agricultural education (*i.e.*, those available to the majority), which suggest that the importance of the countrywoman's position has been understood, and that a definite effort is being made to help her to meet her existing responsibilities better, and to adapt herself to changing conditions so as to extract maximum personal satisfaction from rural life while rendering the greatest possible service to agriculture.

Agricultural Instruction for Women in the Past.—The historical retrospect is somewhat discouraging if voluntary agencies, such as the Women's Institutes, are left out of account. The Agricultural Education Conference of 1915, presenting the first Government report ever issued on agricultural education for women in England and Wales, pointed out that the system of agricultural education in this country had been built up mainly on the requirements of men, and that, with very few exceptions, the instruction available for women consisted of (1) men's institutions which admitted women to the whole or part of their courses, and (2) additional short courses or classes for women which were attached to institutions for men. The report goes on to say that its signatories realised that it was desirable and necessary that facilities for women should form, not an extraneous, but an integral part of the general scheme of agricultural education, but they considered that this could be achieved without that complete neglect of the women's point of view which had been so marked a feature of existing provision. The report then proceeds to review, under the headings of Itinerant Instruction, Farm Institutes, Colleges and University Institutions, the arrangements for agricultural education, as affecting women, in force 10 years ago, notes the deficiencies and makes proposals for reform.

With regard to the first of these divisions, stress was laid on the fact that itinerant instruction, in subjects of special interest to women, was insufficient and unsatisfactory. It was shown that, in a number of counties, there was no provision at all, and that such organised day courses as existed related almost entirely to dairy work, while other branches of

instruction were carried on mainly by means of lectures. It was urged that peripatetic tuition was the only method by which the bulk of the women relatives of small holders and cottagers could be reached, and therefore merited extension. The aim of the local authority, says the report, should be "to give to every young woman in the county from 16 to 20 years of age an opportunity of attending itinerant instruction of a suitable nature." In addition, scholarships, tenable at farm schools, should be available for those attending such classes.

Present Facilities.—The prospect thus envisaged by the Conference is proving slow of realisation—probably because the recommendation that there should be at least two women on every Agricultural Education Sub-Committee has not been translated into an obligation, and there are relatively few women engaged in agricultural instruction. It is true that the volume of peripatetic teaching has increased considerably in recent years, but the extension has not been accompanied by serious endeavour to supply the wants of rural women. Dairy work still forms an honourable exception, as county staffs for agricultural education include a number of capable instructresses eminently fitted to comprehend and supply requirements in this direction.

Other subjects are less fortunate. In the whole of England and Wales there are only two women horticulturists on the staffs of the local authorities, and the diminishing number of women employed as poultry instructresses suggests that the needs of women, who are so generally responsible for poultry management on the farms, are being largely overlooked. Without necessarily assuming that students must always be taught by persons of their own sex, it is a fair inference that, in order to secure the best response, the poultry instructor is likely to be of most service to the commercial producer and the poultry instructress to the wives of the farmers and cottagers.

Past experience in the dairy branch has shown that countrywomen, when approached in the right manner, are extremely appreciative of agricultural education, and it would be reasonable to expect parallel development in other branches if only county staffs contained a larger proportion of women to explore and satisfy the demand. Meantime, an important section of the agricultural community remains practically an undeveloped area as far as agricultural education is concerned, since itinerant instruction as a whole shows no special adapta-

tion to women's requirements, and the Farm Institutes (whose working is outside the scope of this article) only deal with limited numbers in their summer courses.

An Important Development in Derbyshire.—While Agricultural Organisers make every effort to meet any specific request for lectures or courses, elementary agricultural instruction, as far as women are concerned, shows little advance on the position of 10 years ago. In one county, however, there is a pioneer effort to record. Since 1920 there have been held, in the county of Derby, a series of successful day classes for farmers' daughters. In organising these courses, Mr. Bond, the Agricultural Organiser, has been inspired by two leading principles. He considers that, as a partner in the farm or the holding, the women needs, with some slight modification, an agricultural education co-extensive with that of the man. He also believes that if women are once personally convinced of the usefulness of every form of agricultural education they will induce their fathers, brothers and husbands to make use of expert advice and will see to it in time to come that their children have the benefit of such training. The agricultural instruction of women is therefore the surest way of establishing an agricultural community with a belief in the value of education.

These classes for women meet on one day per week for 12 weeks, and are specially designed to benefit farmers' wives and daughters, and other young women interested in farming. Students resident within the administrative county, who punctually attend 10 out of the 12 meetings of each class and who sit for the terminal examination, are entitled to repayment by the committee of two-thirds of the class fee and two-thirds of the approved cost of travelling to and from the places of instruction. Pupils from these classes may compete for the county certificate in agriculture, and a high place in the examination is accounted a good recommendation for a county scholarship. A limited number of members of the women's classes are, on application, admitted to the advanced courses for young farmers, held during the winter.

The syllabus is as under:—

(*a*) *Agriculture.*—Six lessons of 1½ hours each. A concise explanation of certain practical rules and scientific principles that underlie modern progressive farming:

(i) Arable land—features of good management, rotation of crops, use of manures and lime.

(ii) Grass land—features of good management, care and improvement of pastures and meadows.

(iii) Feeding of stock—composition of home-grown and purchased feeding stuffs; principles of economical feeding of horses, cattle and pigs; calf rearing.

(iv) General knowledge—history of farming; correspondence; accounts.

(*b*) *Bee-keeping.*—Two lessons of 1½ hours each. An introduction to modern bee-keeping, comprising the information that beginners require when commencing to keep bees, and during the first year.

(i) The occupants of the hive—queen, workers, drones; the structure of the hive; examination of the combs.

(ii) Management of bees—spring feeding, production and extraction of surplus honey, wintering.

(*c*) *Dairy Work.*—Six lessons, five being of 2 hours each and one of 5 hours.

This subject, which is illustrated by means of practical demonstrations at each lesson, comprises the properties of milk, and its management and conversion into butter and different varieties of cheese.

(i) Milk—its nature and composition, testing for percentage of fat, etc.

(ii) Cream—skimming and separating, ripening.

(iii) Butter—churning, working, making-up and potting.

(iv) Peakland cheese—general principles, method of making and ripening.

(v) Derbyshire cheese—the modern method demonstrated in a dairy.

(vi) Small soft cheeses—cream cheese, cottage cheese, etc.

(*d*) *Domestic Science.*—Four lessons of 2 hours each. In this subject, which also is taught chiefly by means of practical demonstrations, instruction is given in selected parts of Advanced Cookery.

(*e*) *Horticulture.*—Five lessons of 1½ hours each. A short explanation of the gardener's art, with special reference to the management of the farm orchard, kitchen garden and flower plot.

(i) Fruit culture—the planting, pruning and general care of apples, pears, plums, currants, raspberries, gooseberries and strawberries.

(ii) Vegetable culture—the soil and its improvement; planning the cropping; varieties, sowing, manuring, etc., of the chief garden vegetables.

(iii) Flower culture—how to lay out a flower garden; varieties, planting and after management of roses and other flower plants.

(*f*) *Poultry Keeping.*—Three lessons. An explanation of modern methods.

(i) Breeds of poultry, their characteristics and suitability for different purposes and conditions; breeding for egg production, strain.

(ii) Housing, feeding and general management; winter egg production.

(iii) Hatching and rearing; natural and artificial methods.

(*g*) *Veterinary Science.*—Eight lessons of 1½ hours each. A veterinary surgeon's advice in certain matters concerning farm animals.

(i) Nursing of sick animals—preparation of various gruels, mashes, poultices, etc.
(ii) Ailments of young stock—calves, lambs, pigs, foals.
(iii) Wounds and injuries, first-aid treatment.
(iv) Udder complaints.
(v) Pregnancy and parturition.
(vi) Bacteriology—germ life, diseases due to germs.
(vii) Milk hygiene—injurious germs in milk.

The list of subjects admirably illustrates the basic idea of these courses, viz., that women have a general interest in the whole economy of the farm, and a special concern with certain of its branches.

The following method of instruction is pursued:—

In each subject the main points of the day's lesson are circulated to individual members of the class in the form of typewritten notes. These are read through by the teacher, explained more fully, supplemented with additional hints and illustrations, and further discussed until every student understands the lesson and can apply its teaching to the particular branch of farm work, indoor or outdoor, to which it refers. At the end of the lesson a list of questions is given out by which students may test their understanding of the subject; and those who care to write out answers for correction by the teacher are invited to do so. Answering the questions is, however, optional.

This is the fifth year in which these courses have been held at various centres in the county, where suitable accommodation can be found for the lectures, and some provision made for meals. Taking the average attendance as 15 it is computed that upwards of 400 girls have passed through the classes. Past and present students are entitled to copies of the Monthly Bulletin issued by the county agricultural department, which contains valuable articles by past students and by members of the teaching staff. The reunions of old students, too, form a pleasant and useful means whereby touch is maintained with each other.

No one visiting the classes could fail to be struck by the sympathetic character of the instruction and the close attention displayed by the girls, many of whom come long distances and make considerable sacrifices in order to attend. The everyday facts of farm life take on a new interest in the light of theoretic explanation, and the scientific understanding acquired provides a basis for more successful practice in the future. Subjects ordinarily supposed to be rather outside the

range of women's interests are found to be immensely popular. Veterinary science is a case in point. Instruction in the care and nursing of sick animals is particularly appreciated, and the students make excellent use of the knowledge thus acquired.

Mr. Bond's successful experiment in Derbyshire is not only of immediate service to the county, but is an example which might be followed with advantage in other counties where no Farm Institute exists. The experience of Belgium shows that the idea of "travelling farm household management schools" is capable of great development, and that such institutions are of real service to the agricultural community.

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NEW VARIETIES OF BLACK CURRANTS AT WESTWICK.

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THE geographical position of Norfolk, bulging out into the North Sea, is probably an important factor in giving the county its pre-eminent position in the cultivation of black currants. Expert fruit growers from other parts of England who frequently visit our plantations state that the crop cannot be grown on their land as in East Norfolk, and our own observations confirm their statements. With a natural industry of this character skilful cultivation and organisation in growing and marketing the crop are making rapid developments. Our cultivators subject every detail to careful scrutiny, and the advantages and defects of each variety receive decided recognition. Mr. G. Davison, the manager of Colonel B. Petre's extensive fruit farms, was cognisant of all the defects in existing varieties of black currants, and with Colonel Petre's collaboration, began making crosses in 1913 with the object of improving the chief types grown. The promising character of this work was described in a note in this *Journal* in June, 1915, p. 252.

Varieties Used.—Eight parent bushes were used for the work, French Black, Boskoop Giant, Baldwin, and Victoria being the main varieties used.

In *Boskoop Giant* the bush is never well furnished with new shoots. The annual production of new wood is strong, but the number of shoots is deficient. The fruit bunch is long, thinly berried, the berries at the top of the bunch being large and

early ripe, the end berries being small and ripening later. The skin of the berries is thin and tender. Two pickings are necessary to meet the two ripening periods. The fruit will not hang ripe on the bushes for any length of time. The merits of this variety are, easy picking, early ripening, and the fact that the large size of the top berries makes it bold fruit for opening the market. It is not a heavy cropper. To make Boskoop an ideal variety we should require a freer development of shoots, even ripening, larger end berries, less stalk, more berries on the bunch, and a stronger skin to the fruit. The commercial value of all these points is considerable.

In the *French Black* type we have free shoot development, medium sized bunches, average sized fruit, with small end berries. A small increase in the size of the end berries would make a decided increase in the weight of the crop. We sometimes get plentiful rains when the berries are on their final swelling with decided increase in weight per acre of fruit, through the end berries of the bunches swelling to a larger size.

Victoria and Baldwin.—With the two later types represented by Victoria and Baldwin, we have short bunches, set close into the stems, making picking difficult, but the end berries are larger than Boskoop and French. Victoria develops a very large berry with a tough coarse skin, and although the bunch is short, with berries of even size, the ripening is uneven, making the fruit inferior for preserving. Baldwin is a difficult kind to pick, a weak grower, flowers too early, and when it sets a heavy crop, as it occasionally does, the fruit never colours perfectly. These are a few of the points Mr. Davison had in mind when he initiated the task.

The Initial Work.—At the outset the best types of the varieties grown on the farm were selected, and bushes from these selected specimens were grown in pots. A scheme of pollinating the flowers was prepared in tabulated form and each pollination numbered. In the early part of the year the potted plants were placed in a cold greenhouse with ventilators that excluded insects. At the end of March, when the plants were coming into blossom, particular flowers on each raceme were selected and the remainder clipped off. As these selected flowers opened those marked for seed bearing were emasculated before the anthers burst, and when the stigmas were ready they were pollinated with the selected pollen. Crosses were made in such a way that each plant was a seed and pollen bearer for the

whole of the collection. The berries were ripe early in July and were rubbed out, dried, and sown in boxes. Each berry produced about 45 seeds and by the following March 8,000 seedlings were ready for planting in the fields. The planting was carried out in batches under numbers giving the parentage of the plants.

Early Observations.—During the first season each batch of plants showed extraordinary variation in vigour and habit of growth, and it was possible for those acquainted with black currants to name the parents of the different lots by the dominance of recognised features, but decided breaks in habit were noticeable. The leaves in a few plants were peculiarly like those of pelargoniums, while others were sharply dentated. There was no doubt in the first season that a complete mixing of growth habit in the varieties pollinated had been secured. Mr. Davison's aim in making the crosses was to put the desirable features of each kind into one variety, and to cancel the defects.

The seedlings now occupied eight acres of land, and in the second year from planting gave a slight indication, in a few cases, of their fruiting habit. The bushes received the ordinary field culture, and when several seasons had revealed the true character of the growth and fruiting habit, propagation began from the selected bushes under duplicate numbers, that is, the number of the cross and the number of the selection. The cuttings from most of the selected sorts rooted with great freedom, but a few showed the Baldwin trait of not making new roots readily, although in all cases root production is very free when the first new roots have started.

With eight acres of seedlings to select from it was not an easy matter to decide which should be kept or discarded, but those maintained have low numbers, which shows that the best were early recognised, although all of them did not stand the practical field test under comparative conditions with all the named kinds.

Only five varieties have come through the rigorous trials, and as no distinctive names have been allotted to any they are still being grown under their selection numbers.

Description of Selected Varieties.—*No. 8* (Fig. 1) is considered the best currant raised. It is a *French Black* x *Boskoop* with strong free growth; French Black was the seed parent; flowers are in bloom with Boskoop; sets freely and has not run off; ripening period for fruit closely follows Boskoop; fruit bunch is long with thin, wiry stalks and easy to pick; fruit

large with big end berries; jet black in colour; skin thin but strong; flesh green. The fruit hangs well when ripe and the berries do not change the pip colour to red until the fruit gets very stale through hanging too long. It has cropped at five tons to the acre at Westwick and is a considerable advance on all the French Black types now generally grown. The cuttings of this variety root moderately well.

No. 3 (Fig. 2).—This is a *Boskoop* x *French Black* variety with Boskoop as seed parent. At first it was thought that No. 8 was far superior to No. 3, but for four years No. 3 has given quite equal results to No. 8. It is a strong free grower. The flowers come in the same period as Boskoop, are yellow in colour, different from either parent; it sets very freely, nine and ten berries to each bunch; the end berries are large, colour a shiny jet black: fruit has not run off; a very heavy cropper; ripening season closely follows No. 8; strikes readily from cuttings.

No. 7 (Fig. 3) is a *Boskoop* x *Victoria* cross—a very strong grower with thick, large, deep green leaves. It has the Boskoop length of bunch with the large Victoria type of fruit and large end berries; twelve and fourteen berries to the bunch were frequent; fruit is jet black with a tough skin; it is easy to pick and will stand the jarring of packing and travelling perfectly; it does not drop when ripe and follows No. 3.

No. 5 is an *improved Baldwin*, with strong free growth, a long bunch and heavy crop; the ripening period follows No. 7. It is the same in flowering and ripening as Baldwin, but unlike Baldwin roots freely from cuttings.

No. 15 (Fig. 4) is another *Baldwin type*; has the same season for flowering and finishing its fruit as Baldwin; it is a very strong grower and has exceptional fruiting powers. Forty-nine plants of this variety, planted 6 ft. x 3 ft., in the second year of fruiting, yielded a crop equal to 4 tons 17 cwt. per acre.

Conclusions.—These five selected varieties from the eight thousand seedlings have been tried under field conditions in competition with all the well-known sorts. The time involved covers a period of eleven years. Specimens of the fruit have been dispatched in marketing packages to the Wisley and East Malling Research Stations, and the reports from both stations on the appearance, quality, and travelling capacity of the currants were most satisfactory.

Consignments of the fruit of No. 3 and No. 8 were forwarded to a well-known firm of jam makers in Manchester. They boiled

FIG. 1.—Variety No. 8. French Black x Boskoop. Bottom leaves removed to show habit of fruiting.

FIG. 2.—Variety No. 3. Boskoop Giant x French Black.

FIG. 3.—Variety No. 7. Boskoop Giant x Victoria.

FIG. 4.—Variety No. 15. An improved Baldwin Type.

the consignments separately and report that the fruit was very fine indeed, and that they consider they made a perfect jam, rich in colour and flavour and free from tough skins.

I have frequently been asked if these new black currants revert. Mr. Davison does not claim that his new productions are immune to this trouble, but I have not seen any indication of reversion in the plantations of these new varieties. Any variety of black currant will revert if subject to the conditions that are known to cause this trouble. The measures we adopted several years ago of propagation from healthy stock with careful cultivation and avoiding injury to bushes and roots have been entirely successful in reducing reversion to a negligible quantity. Neither Colonel Petre nor Mr. Davison make any startling claims for their new productions in black currants, but they are making their new plantations with these home-raised varieties.

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NOTES ON POULTRY KEEPING.

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SOME sympathy can be extended to the egg farmers who find themselves faced with serious increases in the cost of feeding stuffs at a season when the profits on egg production need to be pretty well assured if the poultry farm is to pay its way. For several years past, following the poultry farming boom which drew so many recruits and a very considerable amount of capital into the industry, warnings have been given by the poultry keeping press and by public speakers on the necessity for economy. Particular attention has been directed to the need for the reduction in feeding costs, and many have benefited by the closer study given to this. More moderate use is now made of Sussex ground oats, a valuable but comparatively costly part of the diet of most well-kept poultry, and the old prejudice against the use of maize for poultry feeding has been further broken down and its value for all classes of poultry stock is more widely realised.

Unfortunately wheat products, which are the staple diet, have risen to an extent which makes the poultry farmer uneasy, but feeding costs are still within reasonable limits for profitable egg production, and generous feeding on sound wholesome cereal foods with a due proportion of animal food included in the diet is the most economical policy. Proprietary poultry laying meals,

many of which are quite reliable and may be useful for buyers of small quantities who have not suitable conditions for buying and mixing their own meals, are not economical for use by commercial egg producers, while spices and condiments for the purpose of stimulating production are extravagant and frequently harmful.

Economy in poultry feeding is frequently misinterpreted by the small-holder. No pullet, however well bred, can produce eggs on short commons, and in spite of all that has been said in the past upon overfeeding as the explanation of poor production it is far more common to find the egg baskets empty owing to restrictions in the diet. Particularly is this the case with the omission, owing to the high price of this class of feeding stuff, of that due proportion of animal food—*e.g.*, fish or meat meal—which is so necessary for the production of eggs during the winter months.

Pullet Eggs.—The early eggs of the pullet, generally well below the standard weight of 2 oz., are a constant source of trouble when it comes to marketing them. The much hackneyed recommendation that these eggs should be consumed at home has become a practical impossibility in these days of increased production. We fear that not only has the production extended with the increased numbers of pullets kept, but the proportion has also grown, and many pullets would never attain to the title of hen if it depended upon the production of a 2 oz. egg. Therefore the practice of selling these small eggs by weight as adopted by the poultry department of the Hertfordshire Farm Institute should commend itself to all concerned in the egg industry. These eggs are sold per lb. at the current market price for first-grade eggs—eggs weighing eight to the lb. This results in the sale of 9 or even 10 of these small eggs at the price of eight eggs of standard weight. We learn that the retailer who buys on these terms and his customers to whom they are offered upon the same basis are well satisfied. This can be understood; it is fair trade and as it should be. A weight of 2 oz. has long been recognised by egg producers as the standard size, and it would probably lead to a much better appreciation of English produce by the wholesale and retail buyer if eggs were sold by weight. We need not at the moment question whether the producer will gain by this particular method, but it ought not to bear denial that in the long run fair trade does redound to the benefit of the producer, and the Herts Institute, as a public institution, must be congratulated upon the success which is meeting a trial of this method.

Egg Grading.—The neglect of grading has for long been a stumbling block to the English egg trade, and it is small wonder that foreign eggs have secured a good footing in our markets owing to the superior organisation possible for the grading of eggs for export. In this country the production and marketing of eggs in small quantities renders grading difficult. It is, however, satisfactory to note the increased attention paid to the grading of eggs in the well-organised auction markets. The sale of eggs by auction is steadily extending, auctions are being held at many fresh centres, and although they are slow to adopt fresh methods poultry keepers are generally finding the introduction of auction sales an improvement upon their previous system. This method probably lends itself better than others to improvements in the grading of eggs. The result to the producer from grading is to some extent dependent upon the auctioneer, but until the market and the method are well established the full benefits are not always realised. The individual has, however, an opportunity to establish his own reputation in the public sale of his eggs, and he is well advised to persevere in the grading of these.

The Sale of Table Poultry.—It is satisfactory to note in the official returns of the London Central Markets for the first nine months of the year that a considerable increase is shown in the amount of British and Irish poultry received. The increase of 1,082 tons, or approximately 16 per cent., is substantial. A close analysis of the supplies is not possible, but there has been definite evidence of a revival in the Sussex fattening industry, from which source an important part of the London supply is drawn. That there is abundant scope for the sale of high-class table poultry in the London markets has always been evident in the past. As in the case of eggs, so it is with poultry, grading to supply a uniform class of produce—whether this is of the special quality of the "Surrey" fowl or fowls of a lower grade—will induce good trade provided the produce is well finished.

There has been a notable decrease, amounting to about 30 per cent., in the supplies of poultry from North America. It can safely be stated that home producers could supply large quantities of chickens of the class required to meet the trade in London catered for by the North American supplies, and the superior condition of freshness in which they could be offered by our own producers would undoubtedly secure them preference—always provided they are offered in a manner to meet the market requirements for convenience in handling.

Laying Tests.—At this late stage, when all the laying tests have commenced, one hesitates to offer advice to competitors who have sent birds—advice which in all probability has to them at least already become apparent, but personal observation has disclosed how common is the mistake of sending birds which are immature. The ultimate result of this would probably be less noticeable in the case of tests at which the scoring is not based in some way on market values, but the strenuous competition extending over 48 weeks, or in some instances considerably less, does not permit the loss of two months, which is the time frequently required to get these birds into laying condition. In spite of repetition of previous notes it may also be pointed out that pullets about to commence laying should possess some reserve store of energy in order to maintain a steady production during the short days and severe weather met with between now and next March. The fine drawn condition of some of the birds when received indicates a lack of appreciation of this point in the selection of birds sent to laying tests.

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NOVEMBER ON THE FARM.

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Weather Notes.—In Anglo-Saxon times, November was styled the wind month, in allusion to the gales which are so prevalent at this season and which strip the trees of their yellowed foliage. It was also known as the slaughter month, partly on account of the sacrificial rites performed during the period about Martinmas, and partly because the grazing and fattening season ended with the slaughter and salting down of the cattle required to provide the winter supply of meat. On the other hand, in modern farm practice, aided by root crops and concentrated foods, November is the beginning of another fattening season.

The typical November day is short, dull and clammy, with heavy dew or hoar frost in the morning and mist or fog in the evening. Temperature considerations are of special importance in this month. If the weather continues mild, grass continues to grow, the cows may still lie out of doors, and late sown wheat is enabled to reach the stage of growth which farmers desire it to attain before the dead season arrives. But if the weather in November is, as it was in 1923, considerably colder than the normal for the month, and frosts of considerable intensity and

duration occur, much damage may be done to potatoes and mangolds that are still in the fields and to corn that is in process of germination.

Over the greater part of England, the thermometer in the middle of November ranges from about 50° F. in the day to about 36° F. in the night, the mean temperature for the month being 43° F. in the Midlands. Night frosts, however, become frequent after the first week, and by the last week the normal mean temperature has fallen to 41° F., below which very little plant growth takes place.

Late Sowing.—The wheat seedling should have formed its third leaf before growth is practically arrested by low temperature. In other words, it should in the Midlands have three leaves by the end of November. If the seed is drilled about the middle of October in a normal season, the first blade appears in some 16 days, the second after 14 more days and the third after a further 16 days. Wheat sown later than the 15th of October may not reach the best stage of growth by the end of November, unless the season is mild or the land favourably situated. The actual length of time required for the production of the first blade, however, is determined by the temperature of the soil and by the depth of drilling. Under November conditions, wheat drilled only one inch deep appears above the ground nearly a week before a similar lot drilled two inches deep, and the colder the land and weather, the greater the retarding effect of deep drilling.

The principal objects of covering seed are to hide it from birds and to place it within reach of a regular supply of soil moisture. In late autumn sowing, there is usually sufficient moisture, but birds become more troublesome as the supplies of other food diminish. For the latter reason and under the mistaken impression that deep covering is a preventive of frost injury, many farmers drill rather too deeply in November. On retentive soil in a wet autumn, many of the seedlings fail to reach the surface, perishing through lack of air; while if frost sufficient to lift the surface occurs when the first blade is just appearing through the ground, the stem may become detached from the seed before the seedling has formed its crown roots. The shallow-drilled seedling, on the other hand, may rise and fall with the soil surface without material injury.

Owing to the heavy mortality which normally occurs among the seedlings of late sown crops, higher rates of seeding are prescribed as the season advances. Generally, a quantity of

13 to 14 stones per acre is allowed in November drilling. If every seed produced a plant, there would be two plants per inch of drill row; but if by March there is one plant in every three inches of drill row, the farmer is satisfied.

Wheat after Green Crop.—Land cleared of potatoes or mangolds during October is often sown with wheat or winter oats early in November. In the case of heavy land early action is required, not only on account of the desirability of "early" sowing, but also because the autumn rains and frosts working on an already fine surface may soon bring about such conditions as prohibit drilling.

Considerable variation may be found in practice with regard to the method of preparing and sowing the corn crop after potatoes or mangolds. Some farmers plough fairly deeply—6 or more inches; while others consider that a furrow of half that depth is sufficient in the circumstances. One reason advanced in favour of the deeper work is that it brings up the residues of the dung that was applied to the green crop; but this raises the question of whether the wheat plant will derive greater benefit from the said residues if so brought up. In one unintentional experiment on heavy land, the writer observed that yard manure applied in early winter after the wheat had been drilled did produce a more vigorous plant than manure applied and ploughed down before drilling.

On heavy land it is probably the best practice to plough the mangold "stubble" about 5 or 6 in. deep with an intact furrow. Land so ploughed will drain and dry somewhat before drilling and lie drier through the winter. Shallow work under such conditions is apt to become beaten down and sodden. On lighter land with free drainage, deep working appears to be neither necessary nor desirable, because of its producing a less firm under-soil than is considered favourable to the wintering of the wheat plant.

It would sometimes be possible to drill on the green-crop tilth without preparatory ploughing; but generally it is desirable to plough in order to obtain a more pervious surface and to secure the requisite sprinkling of small clods. Also on retentive land, surface drainage is promoted by laying the field up in lands. On light soils the seed may be broadcast and covered with a shallow digger-furrow; on heavy land well ploughed with a lea breast, the seed may be broadcast and covered by harrowing. The most generally applicable method, however, if the soil is not too wet, is to plough and drill across the ploughing.

Water Furrowing.—Winter corn on retentive land is often seriously prejudiced by excessive wetness of the surface soil. The effect of such conditions is visible in spring, the plant being backward, stunted and yellow, as a result of deficient aeration and denitrification; while in the wettest places the seedlings may have perished completely. In some districts the necessary surface drainage is provided by ploughing and sowing the land in narrow beds known as stetches. The objection to this practice, in localities where it is not well understood, would be the hindrance to binder-work caused by the many open furrows; but there is undoubtedly a good case for the revival of the almost obsolete practice of water furrowing after sowing winter-corn on heavy land.

A water furrow should not end blindly at the headland, but open into a ditch or on to a grass field. If the field is rather steep, the furrows are better not run up the steepest gradient but obliquely, so that they do not have sufficient fall to carry soil away. A large hollow in the field may well be circumscribed with a water furrow to prevent the inflow of water from the higher ground; and if an outlet can be provided, the hollow itself should be drained with a furrow. Furrows may be cut with a double breast plough; the soil turned out should not, however, be left on the edge of the channel but be thrown back over the land.

Cows in November.—From about the end of October, or a little later in southern districts or mild seasons, cows begin to come indoors at night; and the duration of their daily outrun on the pastures is gradually reduced until by the end of November it amounts to only about a couple of hours during the middle of the day. In some cases, where water is laid on in the stalls, the herd may hardly ever go out of doors between December and April; and, in other cases, during the period mentioned, the cows are released and remain out only for the time they require to drink their fill and while the sheds are cleaned. Further, by restricted or deficient ventilation, the atmosphere in the sheds is kept appreciably warm, in the belief that warm conditions are conducive to good milk yields.

Some years ago the writer, when visiting a large town dairy, inquired why the byre was kept so hot—it was oppressively hot. Three practical men present emphatically urged that such conditions were essential to satisfactory milk production, and called attention to the sleek coats and fine loose skin which they associated with high productivity in the cows. The same

belief is also widely held in rural districts, various devices being adopted to keep the air in the sheds warm and to prevent draughts. Certain farmers, however, have adopted the practice of allowing free ventilation from the time the cows begin to lie indoors in November, and they find that, in spite of the sheds being comparatively cool, the cows milk equally as well as they did when kept warmly housed, while they have fewer cases of chill, garget and other forms of bad luck.

In one case which has come before the writer's notice, the herd is not allowed to become softened by warm housing; but in all weathers the cows—including the deep milkers—receive their root ration thrown out on the grass land. This practice would under some conditions be attended with poached gateways and other inconveniences; it is noteworthy, however, that this herd was one of the most economical producers among about 40 costed in Derbyshire during last winter, and it is remarkably free from chills and udder troubles.

Cows kept in hot byres become sleek in the coat, and they will not stay outside long on a cold winter's day when released for watering. Probably the drop in yield commonly associated with snaps of cold weather is partly due to insufficient drinking: if the weather is very cold the farmer closes the shed up as warmly as possible, but the water outside is colder than usual. That water is not a negligible factor in milk production is indicated by the fact that the installation of indoor watering is generally followed by improved records.

Obviously the proper time to begin the free-ventilation practice is the autumn, when the cows may grow their natural winter coating. "Ventilation without draughts" is an old and accepted principle, but it is not every cowshed that is so furnished with fresh air. From observation, however, the writer has formed the opinion that draughts are not such a serious matter in a cool shed, provided that they play on the fore end of the cow and not the hindquarters.

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MANURES FOR NOVEMBER.

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Manure Value of Foods.—The enrichment of the dung heap and the direct manuring of grazed or folded land through the residues of purchased foods fed to stock is a means of maintaining fertility which is readily adopted by farmers. The extent to

which this is practised can be seen from the following rough estimate, which serves to compare the amounts of fertilising constituents added to the soil annually as the manurial residues of the chief imported feeding stuffs, with those supplied direct in the form of the commonest artificial manures (sulphate of ammonia, nitrate of soda, superphosphate, basic slag, and salts of potash). In 1922 at least 5½ million tons of imported concentrates were fed to stock. From the composition and amount of the individual foods forming this total it can be calculated that the general analysis of the whole would correspond to about 2.5 per cent. of nitrogen, 1.7 per cent. of phosphoric acid, and 0.95 per cent. of potash. Assuming that one-half of the nitrogen and three-quarters of the phosphoric acid and potash find their way back to the land, we obtain:—

Manurial Substances added to the soil in 1922, Great Britain and Ireland.

	Tons.		
	N.	P_2O_5	K_2O
From the chief Imported Feeding stuffs ...	68,000	69,000	39,000
,, ,, ,, Artificial Manures	34,000	107,000	30,000

In addition to the above artificial fertilisers large quantities of organic manures will have been consumed, but the amount of nitrogen they provide has been estimated at only about one-sixth of that from chemical sources.

It is clear that the residues of feeding stuffs account for a very considerable proportion of the nitrogen added to our soils. On the other hand, unless the foods are fed direct on the land, when three-quarters of their nitrogen is reckoned on being returned, only one-half of the nitrogen is regarded as being recovered in ordinary dung management—and the loss may be considerably greater under bad conditions. Dung made and stored in covered, water-tight boxes where enough litter is used may lose as little as 20 per cent. of the nitrogen added in the food, and the nearer the farmer can approach to this standard, within the limits of his local conditions, the better dung will be produced and the more of this enormous supply of plant food will reach the land.

Phosphates for Arable Land.—Winter beans and tares on heavy land, winter corn on late land, and second straw crops under most soil conditions will require phosphatic dressings. These may be given before working down the land for drilling. Although superphosphate may be used for the purpose it is often desirable where lime is deficient to employ some basic or neutral

phosphate such as slag or steamed bone flour, for the autumn application gives these manures the best chance of effective action. Suitable quantities would be 2-3 cwt. of superphosphate or 30 per cent. basic slag per acre, or about half the quantity of steamed bone flour. Where the soil suits superphosphate it is the most certain phosphatic manure for spring application when quick action is essential; but if some neutral or basic phosphate is required and the district is too dry to make spring applications of basic slag or bone manures practicable, the slower acting phosphates may be put on as early as possible in the winter, the actual time depending on the ploughing programme as it would be inadvisable to turn the fertilisers to the bottom of a deep furrow.

Season and Manurial Action.—A manurial scheme may be suited to the soil, but its success will be decided by a factor which is quite out of the farmer's control, namely, the season. Rainfall is the most decisive factor as far as manurial action is concerned. In dry seasons water supply and not plant food is the limiting factor; manures are consequently ineffective and only dung shows anything approaching its normal action—owing to its water retaining power. The poor action of artificial fertilisers in a dry season is well shown by the following figures relating to experiments on potatoes conducted at Rothamsted :—

POTATOES

Increase over Unmanured Land produced by a Complete Mixture of Artificials.

Season.	*Rainfall from September to following August.*	*Increase for Manures.*
1920-21	16.3 in. ...	0.8 tons per acre.
1921-22	29.4 „ ...	5·3 „ „ „
1922-23	26.0 „ ...	4.2 „ „ „

It is often observed that basic slag applied to grass shows little effect if a dry season follows the dressing, but when a normal season comes the clovers respond in the usual way. In the experiments on the influence of manures, soil, and climate on the yield and quality of barley conducted at many centres under the research scheme of the Institute of Brewing, there are indications that the use of phosphates on early soils may in a dry season actually diminish the yield of barley through hastening the plant to maturity before much growth has been made. If drought affects the action of fertilisers adversely, a very wet season is also detrimental to the nitrogenous ones, as the leaching tends to carry the nitrate produced from them out of the reach of the plant. The only remedy the farmer has for

effects of this kind is to maintain a good supply of organic matter in the soil, by the use of dung, the feeding of green crops on the land, or by green manuring. Study of the yields of the Rothamsted plots has shown that those receiving farmyard manure suffer much less seasonal variation than those manured with artificial fertilisers.

Autumn Application of Nitrogenous Manures.—Although phosphate and potash may be applied in autumn more care must be exercised in giving dressings of nitrogen at this time of the year, because all manures of this class give rise to nitrate in the soil which is lost in the drainage water if the crop is not in a sufficiently active state of growth to take it up. Nitrogenous fertilisers fall into four broad classes which are here given in order of availability to the plant, and therefore also of liability to loss by leaching :—

1. Manures such as nitrate of soda or of lime supplying nitrogen in the form of nitrate which is immediately assimilable by the crop.

2. Those, such as sulphate of ammonia and the quick acting part of dung, in which the nitrogen is present as ammonia compounds, and where a bacterial transformation or nitrification which proceeds quickly in summer but slowly in winter converts the ammonia into nitrate.

3. Manures such as meat and fish meals and rape cake, in which the nitrogen is in an organic form and a putrefactive change is required to produce ammonia, which is then nitrified as in the case of sulphate of ammonia.

4. Manures such as shoddy, leather waste, and sewage sludge as ordinarily made, in which the course of transformation is similar to that of the previous class but proceeds much more slowly.

As far as autumn-sown cereals are concerned manures of the first class are not used for winter dressings; sulphate of ammonia—although in continental practice one-quarter of the dressing will often be given in the autumn—is usually reserved for a spring top-dressing in this country. This is in accordance with information obtained from the continuous wheat plots at Rothamsted. where it has been shown that a plot receiving its sulphate of ammonia in the autumn yields less and loses more nitrate in the drainage water than a neighbouring plot which receives the same dressing in spring. On the other hand the amount of ammonium salts (400 lb. per acre) used in this experiment are larger than would be applied to cereals in rotation

cropping, and experiment would be needed to ascertain whether in the drier parts of the country ½ cwt. of sulphate of ammonia per acre, mixed with the phosphatic dressing and applied in autumn, would suffer loss through leaching or would help a plant through the winter on poor tilths. Manures of the third class may be applied in winter or spring as may be convenient, for in winter the processes of decay and nitrification are so slow that little loss need be feared. The slow acting organic manures can scarcely be got on too early, as in any case their complete effect will not be realised in a single season.

A case in which the quicker acting nitrogenous manures might well be used in autumn is where on land in poor condition it is required to force on a good growth of some catch crop such as mustard, rye, or rape for turning in as green manure. The quick acting manure will enable a big bulk of organic matter to be formed in which a large amount of the nitrogen added will be returned to the soil.

Town Refuse.—A farmer has asked for an opinion on the value of a town refuse which he can obtain for 5s. 6d. per ton delivered at a wharf where stable manure costs 11s. 2d. per ton. It is claimed that most of the ashes have been removed from the material, and the organic matter is stated to consist of pulverised paper and vegetable matter. The analysis of the material may be compared with the composition of other refuses as published in these notes from time to time.

Percentage Composition of Town Refuse from various sources.

	A	B	C	D	E
Moisture	11	18	39	24	34
Mineral Matter ...	24	43	42	41	52
Organic Matter ...	65	20	19	32	14
Nitrogen	.94	.36	.78	.33	.55
Phosphoric Acid ...	.17	.37	1.26	.33	.67
Potash	1.06	.32	—	—	.33

It will be seen that the figures for refuse A, the one in question, compare very favourably with the other analyses quoted. It is relatively low in moisture and ash and high in organic matter and in nitrogen. Of the organic matter, paper has very little fertilising value, and any benefit it may produce will be largely due to its physical effect in opening up heavy soil; the vegetable matter will be more useful, as its nitrogen will account for the main manurial value of the material, while its decay in the soil and consequent humus formation will take place quicker than that of the paper. The comparatively small amount of mineral matter and moisture is an advantage, for this raises

the grade of the material and lowers handling costs. Such preliminary experiments as have been carried out at Rothamsted on the comparison of town refuses with London dung show no great difference between their effectiveness when applied in equal weights. Up to the present this has been done on mangolds without artificials. It remains to be seen whether the same will hold when bigger crops are grown with the aid of artificials and the residual effects are ascertained. The refuses, equally with the dung, enabled a good plant of roots to be obtained on difficult land, and much of their value can be attributed to this mechanical action.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Feeding of Work Horses.—In the management of a farm, the horse, particularly in the winter months, plays a very important part, and the horse needs very careful treatment and feeding if he is to respond successfully to the very many calls on his energy that the working of the farm demands. This was demonstrated to the writer very clearly during the early spring of 1917 in France. After the hard winter of 1916, when the Army horses had been wintered under poor conditions of housing and food, they were suddenly called on for the trek up north from the Somme. They responded to the best of their ability, but owing to their poor condition losses were frequent, and the writer was particularly struck with the number of dead horses lying by the roadside all the way up to Poperinghe. It is essential, therefore, if losses on the farm are to be avoided, and if the horse is to work satisfactorily, that he should be adequately cared for and adequately fed.

Horses can be satisfactorily summered on green stuff (vetches, etc.) and straw chaff, but when work is required of them, oats or a similar concentrate, and good hay must form the bulk of the ration. On light work, a certain amount of straw chaff and roots may be fed, but if heavy work is required, the ration must consist almost entirely of oats and good quality hay. Thus the racehorse, which is called upon for sudden and excessive demands upon his energy, is fed on the best oats and

the best hay, an occasional bran mash being given sprinkled with grated carrots to make it appetising. It is, however, possible to effect economies in the ration without interfering with the efficiency of the animal, and the following may serve as a useful guide in suggesting alternative suitable rations for horses at work.

It is rarely advisable to feed more than 20 lb. of hay and straw chop per 1,000 lb. live weight per day to heavy horses, and when severe demands on their energy are not required this amount may drop to below 10 lb. The amount of oats fed may vary from 3 to 18 lb. according to the age and weight of the animal and the nature of the work to be performed.

The following rations, adapted from Klimmer,* may be of value in indicating suitable alternative rations for farm animals :—

I. *Daily Return for Horses at average work, per* 1,000 *lb. L. Wt.*

(1)		(2)		(3)	
Oats	6 lb.	Oats	9 lb.	Maize	5 lb.
Meadow Hay	15 ,,	Meadow Hay	6 ,,	Meadow Hay	6 ,,
Lucerne Hay	6 ,,	Clover Hay	6 ,,	Clover Hay	6 ,,
Wheat Straw	1 ,,	Wheat Straw	2 ,,	Straw	2 ,,
				Earth nut cake	$\frac{3}{4}$,,

(4)		(5)	
Oats	7 lb.	Potatoes	8 lb.
Maize	3 ,,	Carrots	6 ,,
Meadow Hay	5 ,,	Meadow Hay	10 ,,
Oat straw	3 ,,	Clover Hay	3 ,,
Wheat straw	1½ ,,	Wheat straw	2 ,,
Beans	2 ,,	Maize	2 ,,
		Beans	3 ,,

II. *Daily Ration for Horses at heavy work, per* 1,000 *lb. L. Wt.*

(1)		(2)		(3)	
Oats	18 lb.	Oats	5 lb.	Oats	8 lb.
Meadow Hay	6 ,,	Maize	8 ,,	Rye	4 ,,
Wheat Straw	3 ,,	Meadow Hay	8 ,,	Meadow Hay	8 ,,
Beans	2½ ,,	Clover Hay	6 ,,	Lucerne Hay	6 ,,
		Earth nut cake	2 ,,	Linseed Meal	1 ,,
				Earth nut cake	1 ,,

Palm Kernel Cake Meal and Extracted Palm Kernel Meal.— Several correspondents have enquired as to the difference between palm kernel cake meal and extracted palm kernel meal. Both are derived from palm kernels, the essential difference being that the extracted palm kernel meal contains only 2 per cent. of oil, whereas the palm kernel cake meal contains 7 to 8 per cent. of oil. This difference arises owing to differences of treatment

* Scientific Feeding of the Domestic Animals: Martin Klimmen (translation, Paul Fischer).

Description.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	—	—	12/4	12 7	0 15	11 12	71·6	3/3	1·74
Barley, British Feeding	—	—	13/6	13 10	0 12	12 18	71	3/8	1·96
,, American	47/6	400	13/4	13 7	0 12	12 15	71	3/7	1·92
,, Danubian	47/6	,,	13/4	13 7	0 12	12 15	71	3/7	1·92
,, Karachi	48/-	,,	13/5	13 8	0 12	12 16	71	3/7	1·92
Oats, English, White	—	—	10/4	10 7	0 13	9 14	59·5	3/3	1·74
,, ,, Black and Grey	—	—	9/10	9 17	0 13	9 4	59·5	3/1	1·65
,, Irish Black	—	—	10/4	10 7	0 13	9 14	59·5	3/3	1·74
,, Canadian :—									
No. 2 Western	36/6	320	12/9	12 15	0 13	12 2	59·5	4/1	2·90
Feed	33/6	,,	11/9	11 15	0 13	11 2	59·5	3/9	2·01
,, Argentine	30/9	,,	10/9	10 15	0 13	10 2	59·5	3/5	1·83
,, Chilian	31/3	,,	10/11	10 18	0 13	10 5	59·5	3/5	1·83
Maize, Argentine	45/6	480	10/7	10 12	0 13	9 19	81	2/5	1·29
,, Odessa	45/-	,,	10/6	10 10	0 13	9 17	81	2/5	1·29
Beans, English Winter	—	—	11/6	11 10	1 11	9 19	67	3/-	1·61
,, Rangoon	—	—	11/6	10 10†	1 11	9 19	67	3/-	1·61
Peas, English	—	—	17/2	17 3*	1 7	15 16	69	4/7	2·45
,, Japanese	—	—	22/6	22 10†	1 7	21 3	69	6/2	1·30
Rye, Homegrown	—	—	10/7	10 12	0 15	9 17	71·6	2/9	1·47
Millers' Offals :—									
Bran, British	—	—	—	8 10	1 6	7 4	45	3/2	1·70
,, Broad	—	—	—	9 5	1 6	7 19	45	3/6	1·87
Middlings—									
Fine Imported	—	—	—	10 15	1 1	9 14	72	2/8	1·43
Coarse, British	—	—	—	10 2	1 1	9 1	64	2/10	1·52
Pollards, Imported	—	—	—	8 17	1 6	7 11	60	2/6	1·34
Meal, Barley	—	—	—	14 7	0 12	13 15	71	3/10	2·05
,, Maize	—	—	—	12 0	0 13	11 7	81	2/10	1·52
,, ,, Germ	—	—	—	12 0	0 18	11 2	85·3	2/7	1·38
,, ,, Gluten Feed	—	—	—	10 15	1 6	9 9	75·6	2/6	1·34
,, Locust Bean	—	—	—	10 0	0 9	9 11	71·4	2/8	1·43
,, Bean	—	—	—	14 0	1 11	12 9	67	3/9	2·01
,, Fish	—	—	—	20 0	4 3	15 17	53	6/-	3·21
Linseed	—	—	—	23 10	1 10	22 0	119	3/8	1·96
,, Cake, English 12% Oil	—	—	—	14 17	1 17	13 0	74	3/6	1·87
,, ,, 10% Oil	—	—	—	14 2	1 17	12 5	74	3/4	1·78
,, ,, 9% Oil	—	—	—	14 0	1 17	12 3	74	3/3	1·74
Cottonseed Cake, English 5½% Oil	—	—	—	9 10	1 13	7 17	42	3/9	2·01
,, ,, Egyptian 5½% Oil	—	—	—	8 17†	1 13	7 4	42	3/5	1·83
Decorticated Cotton Seed Cake 7% Oil	—	—	—	13 12	2 12	11 0	71	3/1	1.65
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 10	2 12	10 18	71	3/1	1.65
Coconut Cake 6% Oil	—	—	—	11 15	1 9	10 6	73	2/10	1·52
Palm Kernel Cake 6% Oil	—	—	—	9 5†	1 2	8 3	75	2/2	1·16
,, ,, Meal 2% Oil	—	—	—	8 5	1 3	7 2	71·3	2/-	1·07
Feeding Treacle	—	—	—	7 15	0 8	7 7	51	2/11	1·56
Brewers' Grains :—									
Dried Ale	—	—	—	8 5	1 3	7 2	49	2/11	1·56
,, Porter	—	—	—	7 15	1 3	6 12	49	2/8	1·43
Wet Ale	—	—	—	1 2	0 9	0 13	15	-/10	0·45
,, Porter	—	—	—	0 17	0 9	0 8	15	-/6	0·27
Malt Culms	—	—	—	8 10	1 13	6 17	43	3/2	1·70

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of September and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives

in the extraction of the oil—from the seeds, which contain no less than 49 per cent. of oil. In the one process, the ground kernels are placed in coarse bags which travel through roller presses. These presses squeeze out most of the oil from the meal, and the meal in the bag adheres together owing to the heavy pressure and forms the palm kernel cake of commerce. This cake contains from 7 to 8 per cent. of oil, since it is impossible to extract more oil from the meal by a press process. In order to reduce the cake to a suitable form for pig-feeding, certain manufacturers regrind it, and this appears on the market as palm kernel cake meal.

In treatment by a second process the ground kernels are treated with a suitable solvent, which dissolves out the oil. By suitable methods the solvent containing the oil is removed, and the meal, which still is impregnated with some of the solvent, is heated in suitable containers, to remove the last traces of solvent. The dry friable meal thus resulting is known as palm kernel meal or extracted palm kernel meal, and contains from 1 to 2 per cent. of oil. The experiences of practical stock-feeders have shown that, as a general rule, animals apparently do better on, and certainly prefer, the palm kernel cake meal. Whether this preference is due to the presence of the oil, or whether it is due to differences of treatment, is not clear.

* * * * * *

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·29	2 5	71·6	8 13	0 15	9 8
Oats	1·29	2 5	59·5	7 4	0 13	7 17
Barley	1·29	2 5	71·0	8 12	0 12	9 4
Potatoes	1·29	2 5	18·0	2 3	0 3	2 6
Swedes	1·29	2 5	7·0	0 17	0 2	0 19
Mangolds	1·29	2 5	6·0	0 15	0 3	0 18
Good Meadow Hay	1·56	2 11	31·0	4 10	0 13	5 3
Good Oat Straw	1·56	2 11	17·0	2 10	0 6	2 16
Good Clover Hay	1·56	2 11	32·0	4 13	1 0	5 13
Vetch and Oat Silage	1·43	2 8	14·0	1 17	0 7	2 4

NOTE.—In arriving at the figures for "value per ton on farm" in the September issue of the *Journal* (p. 589), the "manurial value per ton" was *deducted* from the "food value per ton" instead of being *added*, so that the figures in the last column of the above table were incorrect.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending October 22nd.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	13.17	13.12	13. 7	17. 3
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13. 1*	13. 1*	13. 1*	13. 1*	(N)12. 7
„ „ „ neutral (N. 21.1 per cent.)	14. 4*	14. 4*	14. 4*	14. 4*	(N)13. 6
Kainit (Pot. 12½ per cent.)	...	..	...	2. 2	3. 5
French Kainit (Pot. 14 per cent.)	2.15	2. 6	2. 5	2. 5	3. 3
„ „ (Pot. 20 per cent.)	2.19	2.11	...	2.10	2. 6
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.10	2. 7	2. 4
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	6.10	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	11.10	11. 5	4. 8
Basic Slag (T.P. 30 per cent.)	3. 2	...	2.12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 7	1.11
„ (S.P. 30 per cent.) ...	3 5	3. 5	3. 8	3. 1	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8. 7	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	7. 7†	6. 0	6. 2†	...
Fish Guano (N. 7½-8¼, T.P. 16-20 per cent.)	12.15	....	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ..	...	...	...	13. 7	...
Burnt Lump Lime	1. 8	...	...	2. 2§	...
Ground Lime	1.14	...	...	1.16§	...
Ground Limestone	1. 1	...	...	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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FARM SETTLEMENTS FOR EX-SERVICE MEN.

A REPORT by the Ministry of its Proceedings under the Small Holdings Colonies Acts, 1916 and 1918, and the Sailors and Soldiers (Gifts for Land Settlement) Act, 1916, covering the two years, 1921-2 and 1922-3, has just been published.* The Report is of interest not only to County Councils and the Councils of County Boroughs, which exercise the powers conferred on them by the Small Holdings Act, 1908, and the Land Settlement (Facilities) Act, 1919, but to all who are interested in the settlement of ex-Service men on the land and the extension of small holdings in this country.

* Price 3s. 6d. net, obtainable from H.M. Stationery Office, Kingsway, London, W.C.2.

The Report is concerned with a small part only of the complete scheme for the settlement of ex-Service men on the land, namely, the work of the Ministry itself in settling ex-Service men on small holdings and profit-sharing farms by direct administration. A report on the administration of the Land Settlement (Facilities) Act, 1919, which authorise the settlement of ex-Service men on the land through the agency of county councils and councils of county boroughs, is now in preparation.

The revised policy described in the Ministry's last report, for 1919-20 (Cmd. 1184), has now been completely carried out so far as practicable, and it is possible to summarise the results finally attained. The number of ex-Service men settled is 567, of whom 153 are on small holdings with a total area of 2,323 acres, which have been transferred to the ownership and management of the county councils in whose areas they are situated; 331 on small holding settlements which are retained under the Ministry's management; and 83 on profit-sharing farms, also managed by the Ministry. In addition there are 135 non-Service men on small holding settlements, and 24 on profit-sharing farms, the majority of whom were working on the estates when they were acquired by the Ministry.

An important feature of Land Settlement is the increase of the population on the land which results from the development of estates either as small holdings or profit-sharing farms. The number of ex-Service men settled may appear small as compared with the work and expenditure involved. It is necessary, however, to consider not merely the number of tenants or wage-earners, but the total increase in population which has taken place.

On the estates retained by the Ministry the total resident population before their acquisition by the Ministry was 741, while on 1st April, 1924, it had increased to 1,724, a gain of 983, or 133 per cent.

Profit-Sharing Farming.—Two properties have been retained by the Ministry for the purpose of continuing the experiment in profit-sharing farming. These consist of 2,304 acres at Amesbury, Wiltshire, and 2,363 acres at Patrington, East Yorkshire. At Amesbury 23 ex-Service men, and at Patrington 59 ex-Service men, have been settled on the farms. Practically the whole of these, owing to lack of capital and, in many cases, experience also, would not have been accepted as tenants of small holdings. Steps have since been taken to decentralise administration, and in no sense can it be said that either undertaking is being farmed from Whitehall Place.

Amesbury Settlement.—Although it happens that both settlements incurred a farming loss in these two years for reasons which every farmer will appreciate, their general position is very different. The outlook, both financial and administrative, of the Amesbury Settlement is very favourable. The Director, Mr. Charles Sandell, a farmer with long experience of agriculture in that district, has been given entire responsibility for the farming of the settlement since April, 1923. The Ministry entered into occupation when the ingoing was at its zenith. Since that date valuations have had to be written down drastically. Nevertheless, in a period of four years ended 31st March, 1923, this farm has paid to the Treasury £4,367, and to the settlers £1,711 by way of interest on farming capital and profit. The Treasury has received slightly more than 7 per cent. per annum on the sum it has advanced for farming capital at this settlement. In dealing with agriculture, perhaps more than with other industries, it is risky to assume the role of prophet, but it will not be surprising if, given reasonable seasons and prices, the farming account at Amesbury shows a sufficient profit during the next three or four years to make the position of "profit-sharing settler" a substantial improvement on that of the ordinary agricultural labourer.

As regards the Patrington settlement the position is different. In the district the custom is to employ as a permanent staff only a few married men with a number of single men who live in bothies. This permanent staff is supplemented as required by temporary imported labour. The Ministry's object, however, being to settle ex-Service men on the land, it was necessary to build cottages sufficient to house a permanent staff of married men. With the subsequent fall in the prices of agricultural produce, more particularly wheat, and the value of all farming stock, there has been no chance of the turnover becoming sufficient to meet depreciation and overhead charges.

* * * * * *

Rationing of Dairy Cows.

THE quantity of milk yielded by a cow is directly affected by the quantity and quality of her food. The first principle of economical feeding is to ascertain by carefully kept records, the milking capacity of each cow, and to regulate accordingly, the nature and quantity of the food given to her.

This method of systematic rationing is rapidly becoming more popular amongst dairy farmers, and definite schemes for giving scientific advice to them are being operated in many

counties by Local Education Authorities, usually through the agency of Milk Recording Societies.

These schemes at present show certain points of divergence, and in order, *inter alia*, that they may be more closely compared, the Ministry has set up the following Committee to consider and advise as to a uniform scheme of rationing of dairy cows for general adoption:—

Mr. J. F. Blackshaw (Chairman), Mr. G. T. Dixon, Mr. J. G. Stewart,	of the Ministry of Agriculture and Fisheries.
Mr. G. H. Garrad,	Agricultural Organiser for Kent.
Mr. E. T. Halnan,	School of Agriculture, Cambridge.
Mr. J. Mackintosh,	National Institute for Research in Dairying, Reading.
Mr. H. R. J. Holmes,	Institute for Research in Agricultural Economics, Oxford.
Mr. T. E. Jarvis,	of the Ministry of Agriculture and Fisheries (Secretary).

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Angora Rabbit Wool Production.

THE following notes on two recent visits paid by one of the Ministry's Small Live Stock Inspectors to keepers of Angora rabbits on a fairly large scale, may be of interest to those who have read Mr. Watmough's article on "Angora Wool Production" in the February issue of this *Journal*, p. 1051.

Mr. A. keeps about 300 Angora rabbits and disposes of the wool to mills in the Midlands at the rate of 35s. per lb. for the best quality. The price was 40s. per lb. until a few months ago. Mr. A. estimates that it costs about 8s. 6d. per head per annum for the food and bedding of his rabbits. The food consists of ordinary oats, Sussex ground oats and bran mash, with green food and water *ad lib*. The rabbits are kept in hutches 18 in. sq., though it is now considered that 20 in. sq. is a more suitable size. The hutches are arranged in tiers with felt between the tiers. The stock consists of English bucks and a mixture of English and foreign does. At the time of the Inspector's visit all the rabbits looked very healthy. Each doe rears three families per annum. Each rabbit produces about 14 oz. of wool per annum.

Mr. B.'s farm has a capacity for some 250 rabbits, but the demand for stock rabbits has been so great that this number has not yet been reached and at present there are only about 150. Mr. B. considers that it is far preferable to clip the wool regularly four times a year, than to get it by pulling or combing, as by this means the length of the wool is more even.

Mr. B.'s rabbits are groomed twice a week and are kept on practically the same system as Mr. A.'s. He prefers the English rabbit to the French as it has a much finer coat.

The Inspector understood that it was considered that one man should be able to look after 250 rabbits if they are kept for wool only. Also, that although large quantities of wool can be bought on the Continent, at a lower price than the English, the English is preferred and there is a considerable demand for it. It would therefore appear that the outlook for this small industry is promising.

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Variety of Potato Immune from Wart Disease.

IN the report on the Wart Disease Immunity Trials carried out at Ormskirk in 1923 (see this *Journal*, March, 1924, p. 1170) it was stated that in addition to the varieties mentioned therein, the Ministry was prepared to include other varieties which had successfully passed the test when the growers signified their intention of introducing them into commerce.

This intention has now been notified in regard to the variety "Glenalmond," and it has accordingly been added to the official list. The following is a description of this variety:—

Late or maincrop variety.

(1) *Sprout.*—Reddish purple.

(2) *Tuber.*—Oval; white skin, flesh pale lemon; eyes shallow.

(3) *Haulm.*—Upright, open appearance; weak habit of growth; leaflets small; dull, smooth leathery appearance; base of stem and leaf stalks bronzed.

(4) *Flowers.*—White, rare.

* * * * * *

Importation of Bulbs into the Isles of Scilly. — The importation of bulbs into the Isles of Scilly has been restricted since the 1st January last by the Bulb Disease (Isles of Scilly) Order of 1923, which requires every consignment of daffodil or narcissus bulbs landed in the Isles to be accompanied by a certificate that they have been examined and found to be free from disease, or a declaration that they have been submitted to the hot-water treatment.

At the request of the growers in the Islands the Ministry has issued an amending Order—the Bulb Diseases (Isles of Scilly) Order of 1924—which came into operation on the 1st October. Under this Order, the landing of daffodil and narcissus bulbs in the Scilly Isles may be licensed by an Inspector of the Ministry, on condition that the bulbs are sent direct to the Bulb Treating Station which has been established at St. Mary's by the Agricultural Committee of the Isles of Scilly, and there submitted to the hot-water treatment before being handed over to the actual consignee.

Importation of Pure Bred Stock into the United States.—With reference to the Notice which appeared on page 474 of this *Journal* for August, 1923, slightly revised regulations have now been issued on the subject of the importation of pure bred live-stock into the United States. The new Order (B.A.I. Order No. 288) issued by the Department of Agriculture (Bureau of Animal Industry), involves, with very little variation, the same procedure as that described in the issue of the Journal referred to above, but the following British breeds are added to the list of those recognised by the United States Department of Agriculture:—"Alderney" cattle, and "Large Black" pigs.

* * * * * *

Foot-and-Mouth Disease.—The position became increasingly favourable towards the close of September, four outbreaks only having been confirmed during the week ended 21st September, in Essex, Kesteven, Northants and Notts, the last of which was that in Northants on the 21st September, from which date there was no outbreak in any part of Great Britain until the 17th Oct.

The areas under restrictions in connection with these and earlier outbreaks were released from such restrictions as from the 25th Oct.

On the 17th Oct., a fresh centre was brought to light by the confirmation of disease at Wymondham, Melton Mowbray, Leicestershire, necessitating the application of restrictions to the usual 15 miles area. On the 20th Oct., disease was found to exist at North Wingfield, Derbyshire, in respect of which similar action was taken, the area being extended in view of the possibility of Derby market having been implicated. On the 24th Oct., a third centre occurred, disease being found at Martham, Norfolk.

The origin of these new outbreaks is at present not known. Local spread to other premises in the neighbourhood has occurred in the Leicestershire area (one case) and in the Derbyshire area (two cases), making a total of 6 outbreaks from the 17th Oct. to the 24th Oct.

* * * * * *

REPLIES TO CORRESPONDENTS.

Strawberry Cultivation and Insect Pests.—X. inquired on this subject and a reply was sent as follows:—

Reply: In reply to your enquiry, in a general way strawberries are probably one of the least satisfactory crops to plant upon recently broken grassland, as they are almost certain to be attacked by the pests almost inevitably present. After the turf has rotted, and if no grass was allowed to grow as a weed, there would not be great danger from leather jackets after the first attack had taken place, as the grubs present would become adult flies which would migrate to grass. It is almost certain, however, that the damage by leather jackets is also largely supplemented by wireworms—the larvæ of the click beetle—which take several years to come to maturity.

Unless it is quite essential that strawberries should be planted, potatoes are suggested as the most satisfactory crop to clean the land. Under this crop the land becomes thoroughly worked and the crop itself acts as a trap crop for wireworms. A large proportion of these are frequently removed in the tubers when the potatoes are dug, leav-

ing the ground in a more satisfactory condition. Some suggestions for the control of leather jackets are contained in Leaflet No. 11, but the planting of strawberries until the ground has been at least one year under another crop after being ploughed in is not advised.

In respect of Plot 1 proving more satisfactory than Plots 2 and 3, the reason is probably due to the fact that the leather jackets were very much younger in December, and therefore more susceptible to damage and weather conditions than the leather jackets in Plots 2 and 3, which were not interfered with until February. This is a possible explanation, but it is difficult to speak with certainty without an examination of the plots on the spot.

Chrysanthemum Fly.—Miss J. N. G. sent damaged chrysanthemum leaves, for advice.

Reply: The chrysanthemum leaves have been subject to attack by the larvæ of the Chrysanthemum Fly (*Phytomyza chrysanthemi*).

When this pest has once become thoroughly established on the plants in considerable numbers, it is extremely difficult to control, but its attacks are readily prevented from becoming severe by the removal of all leaves which show signs of being affected in the early stages of attack. A severe infestation may be partially controlled by a very strong solution of nicotine and soap; this, however, is expensive, and it is preferable to remove and destroy attacked leaves by hand when this is possible.

Currant Clearwing Moth.—F. G. P. inquired about damaged currant bushes.

Reply: Judging from the description given in the letter the currant bushes appear to have been subject to attack by larvæ of the Currant Clearwing Moth, which is a white caterpillar, and bores into the stems as described.

The remedy would be severe pruning and the cutting out of any branches which appear to be unthrifty and show signs of harbouring the caterpillars.

It hardly seems likely, however, that these larvæ are responsible for the failure of the whole crop.

Haymaking in Norway.—N. T. asks for particulars as to the method adopted.

Reply: Leaflet No. 46 of the Board of Agriculture for Scotland (a reprint of an article which appeared in the "Transactions of the Highland and Agricultural Society of Scotland," Vol. X, 1898), was sent. Reference was also made to an account in "Landtmannen," 1921, p. 702, of experiments carried out in Northern Sweden, and a sketch illustrating the arrangement of uprights and cross-bars was enclosed. A method in vogue in Finland was also described. This consists in building a pyramidal trestle of poles about 6 or 7 feet high, with cross-bars, upon which the hay-cock is piled.

Economic Use of Reeds.—O. V. forwarded a specimen of a reed and asked for what purposes it could be utilised.

Reply: The specimen submitted for identification is *Scirpus lacustris* Linn., the Great Club-rush, Boulder or Bulrush, a common sedge widely distributed in temperate countries and well-known as a material for making mats, baskets, and various articles for local use in the different

countries in which is is commonly found. The stems are also used by coopers for placing between the staves of casks. In the Museum at Kew there are specimens of baskets, a beehive, horse-collar, hassock, etc., made in Norfolk.

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NOTICES OF BOOKS.

Recent Developments in Cattle Breeding.—(Dr. G. F. Finlay. Edinburgh: Oliver and Boyd.) This brochure is a reprint of a pamphlet prepared for the Scottish Cattle Breeding Conference held in Edinburgh in July last. The author is a member of the staff of the Scottish Research Institute in Animal Breeding. His endeavour is to set out in simple language some of the more recent theories and results published by students of the new science, Genetics. The conference in question was an attempt (and a highly successful attempt) to bring together scientists and practical breeders from all parts of the globe with a view, mainly, to enlisting the sympathies of cattle breeders in the attempts that are being made to introduce science into their practice.

Coming from the source from which it does, the treatise under notice must be accepted as accurate scientifically; the only criticism possible from the expert point of view is that it might have been well to distinguish between statements constituting a working hypothesis and the actual observed facts upon which the hypothesis is based. The statement, for example, that the occasional appearance of reds in the black Polled Angus breeds can be explained on the simple Mendelian basis of the dominance of black over red cannot be said to have been confirmed on a rigid experimental basis. It may, however, fit facts as reported, and from a practical point of view is a theory that may be adopted as a working rule.

The little book may be recommended to practical men who wish to study current "genetic" literature. We say "study" advisedly, for one of the first difficulties they encounter in such literature is the free use of a number of new words (such as homozygous"). A new science requires a new terminology, new words are required to express new ideas—always remembering that new ideas spring from the observation of new facts But there is another obstacle which may be encountered. Old words are sometimes used to express new ideas. On the opening page we find it stated "in these cases there are two types of offspring, viz., one group which are 'pure' for polled and the other of the cross-bred type." The word "pure" in the above extract is used in the Mendelian sense of pure in so far as the unit pair of characters of polled and horned are concerned. In popular language, on the other hand, pure bred connotes a particular variety and the possession of a number of characters.

The short chapters on "The Cell in Growth and Reproduction," "Fertility and Sterility," and "Inbreeding" are particularly valuable as introductions to the scientific—or accurate—treatment of facts hitherto observed and represented by a mass of unconfirmed tradition.

The future publication of the comprehensive treatise on Cattle-Breeding, which is promised on the page headed "Contents," will be awaited with interest. The Edinburgh Conference was the first of its kind, and the valuable introductions made by a number of American authorities who attended should prove especially interesting.

ADDITIONS TO THE LIBRARY.

'lant Diseases.

North Dakota Agricultural Experiment Station.—Bulletin 176 :—Ergot and its Control. (23 pp.) Agricultural College, N.D., 1924. [63.24.]

U.S. Department of Agriculture.—Dept. Bulletin 1253 :—Diseases of Apples on the Market. (24 pp.) Washington, 1924. [63.24-41.]

ive Stock and Feeding Stuffs.

British Oil and Cake Mills, Ltd.—The System of Balanced Rations for Stockfeeding. (32 pp.) Hull and London, 1924. [63.6043.]

Finlay, G. F.—Recent Developments in Cattle Breeding. (62 pp. and 4 pl.) Edinburgh and London : Oliver & Boyd, 1924, cloth 2s. 6d. net, paper 1s. net. [63.603; 63.62.]

Ohio Agricultural Experiment Station.—Bulletin 367 :—A Comparison of Types of Lambs and Systems of Production. (pp. 182-239.) Wooster, 1923. [63.631.]

Oklahoma Agricultural Experiment Station.—Bulletin 144 :—Effect of Protein and Mineral on the Development of Swine. (27 pp.) Stillwater, 1922. [612.394; 63.64 : 043.]

Illinois Agricultural Experiment Station.—Bulletin 250 :—The Value of Mineral Supplements in Swine Feeding. (pp. 87-110.) Urbana, 1924. [63.64 : 043.]

Texas Agricultural Experiment Station.—Bulletin 315 :—Digestion Experiments with Oat By-products and other Feeds. (12 pp.) College Station, Brazos County, 1924. [63.60433.]

Economics.

Gray, L. C.—Introduction to Agricultural Economics. (568 pp.) New York and London : Macmillan, 1924, 12s. [338.1.]

Lloyd, E. M. H.—Experiments in State Control at the War Office and the Ministry of Food. [Carnegie Endowment Economic and Social History of the World War. British Series.] (460 pp.) Oxford : Clarendon Press, 1924, 10s. 6d. [338.99; 63(08).]

Is Unemployment Inevitable? An Analysis and a Forecast. A continuation of the investigations embodied in "The Third Winter of Unemployment" published in 1923. (396 pp.) London : Macmillan, 1924, 8s. 6d. [338(42); 331(42).]

Fordham, Montague.—The Rebuilding of Rural England. (222 pp.) London : Hutchinson & Co., 1924, 10s. 6d. net. [338.1(42).]

Irish Free State.—Reports of the Commission on Agriculture. (115 pp.) Dublin : Stationery Office, 1924. [63(415); 338.1(415).]

Clapham, J. H.—The Economic Development of France and Germany 1815-1914. 2nd Edn. (430 pp.) Cambridge : University Press, 1923, 16s. net. [338(44) (43).]

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NOTES FOR THE MONTH.

New Minister of Agriculture and Fisheries.

On the formation of the new Government in November, the Rt. Hon. E. F. L. Wood, M.P., was appointed Minister of Agriculture and Fisheries, and Lord Bledisloe has been appointed Parliamentary Secretary.

*   *   *   *   *   *

The following statement was issued to the Press by the Ministry on 27th November:—

Conference on Agricultural Policy.

1. The Government has given careful consideration to the question of the action that should be taken to deal with the agricultural problem.

2. There have been many previous inquiries into the position of agriculture in recent years, notably by Lord Selborne's Committee on Agricultural Policy and by the Agricultural Tribunal of Investigation. Much valuable material and information is contained in their Reports, but hitherto it has not been possible to obtain agreement either in the industry itself or by the country as a whole as to the main principles of a national and stable agricultural policy.

3. The Government is, however, deeply impressed with the vital importance of the basic industry of agriculture in the national economy, and it is of opinion that a fresh attempt should be made to arrive at an agreement as to the measures which are necessary to secure the objects which all parties in the country unite in desiring.

4. Those objects are that the industry should be conducted in such a manner as will secure the maximum employment of labour at reasonable rates of wages, together with the full use of the land for the production of food at the lowest possible prices consistent with a fair return to all those engaged in the industry. Unless these objects can be simultaneously attained, no measures

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for the relief of agriculture or for the assistance of any particular section of the industry will secure the lasting support of the industrial population of the country, and from the point of view of the workers in the industry no measures for the statutory regulation of wages will in themselves enable wages to be paid that are in fact uneconomic.

5. If, however, agreement could be arrived at as to the measures which would secure the objects mentioned above, the Government is of opinion that it could be presented to the country with a good prospect of acceptance. From the point of view of labour the decline of agriculture is a serious menace to employ-
ment in other industries and has a depressing effect upon wages,
and the whole population as consumers of food is vitally interested
in the maintenance of a prosperous agriculture without which
the supply of home-produced food is bound to shrink. From
the social point of view also the maintenance of a a healthy rural
population is of the first importance, and the Chief Medical
Officer of the Board of Education has in his recent Report lent
his authority to some disquieting observations which suggest
that in some parts of the country there is a decline in the general
physique of many country children. In so far as this decline
may be a reaction from the general agricultural problem, it strongly enforces the necessity of making every effort to effect an improvement in agricultural conditions.

6. On these grounds the Government has decided, as an initial step, to summon a Conference of representatives of the three principal agricultural interests, viz., landowners, farmers and workers, in the hope that by concerted discussion and inquiry such a Conference will arrive at agreed conclusions as to the main features of a national agricultural policy, which would give confidence and stability to the industry and would be likely to be acceptable to the country as a whole.

7. The Government realises that any such Conference must be supplied with as clear and precise a statement as possible of the means which must be adopted in order to attain the objects set out in paragraph 4 above.

8. In the opinion of the Government, it is of primary importance to maintain and, if possible, increase the area of arable land. The cultivation of arable land as compared with permanent grass may be said in broad terms to provide employment for a greater number of men and also to give a larger amount of saleable agricultural produce per acre. The maintenance and extension of the arable area corresponds, therefore, with the national

needs by providing a greater production of food and greater employment.

9. The Government accordingly proposes that the reference to the Conference should be *to consider what measures, if any, are necessary either by the State or by the agricultural industry itself or by both in concert* (1) *to maintain and* (2) *to increase the area of arable land in England and Wales, and by what further measures the economic maximum production of food from all the agricultural land of the country can be stimulated.*

10. It will not be necessary for the Conference to enter into a detailed examination of questions of food prices, as these have already been considered by the Linlithgow Committee, and have been referred for further examination to a Royal Commission.

11. In considering the reference, too much weight should not be given to the production of wheat to the exclusion of other arable crops. Land in arable cultivation can, in an emergency, be diverted to wheat, and in normal times it is not in itself a national necessity to grow wheat to an extent greater than is economically profitable. What *is* required is the maintenance of land in arable cultivation together with the necessary farming experience, the supply of skilled agricultural labour and the implements, buildings and drainage which will enable that land to be devoted to wheat growing if the necessity arises.

12. In regard to the maintenance of the existing arable area, which is now practically the same as it was prior to the War, the Government desires the Conference to consider and report whether under present conditions it is likely that it will be substantially reduced and, if so, to what extent, in the absence of any positive steps to arrest any further decline. If the Conference comes to the conclusion that the area will be reduced, they are invited to indicate what measures would be effective to prevent it.

13. The Government also desires the Conference to report what further measures would have to be taken in order to secure an increase in the existing area of arable land, having due regard to the necessary limitations of soil and climate. For this purpose it is suggested that any measures recommended should be sufficient to secure an addition of not less than 1,000,000 acres to the area of arable land, which would be an increase of approximately 10 per cent.

14. The Conference should also bear in mind the fact that the problem is not merely one of acreage. It is even more

important that any measures recommended should be designed to secure the highest possible standard of profitable production from all the land of the country, whether arable or grass. It cannot be doubted that there is room for great improvement, particularly in regard to the productive capacity of grassland. There has been too much tendency to consider the agricultural problem in terms of corn growing alone, whereas the live stock industry, in its wide sense, including meat of all kinds, milk, butter, cheese, poultry and eggs accounts at the present time, for probably three-fourths of the total annual value of the agricultural production of the country, while potatoes together with fruit and vegetables represents another 10 per cent. An increase of these forms of production, though not in all cases affecting the problem of employment so directly, is, in the opinion of the Government, of very great importance in the national interest.

15. It is the intention of the Government in calling the Conference to give the industry itself an opportunity of formulating for the consideration of the country as a whole a policy which will secure the attainment of the objects indicated above, and it is hoped that as the period of acute depression since the War appears to be over, and as the agricultural outlook is now brighter, the Conference will be enabled to consider the problem in an atmosphere undisturbed by abnormal conditions or by demands for emergency measures of relief.

16. The Government considers that the Conference should be responsible for its own proceedings and conclusions, but it will be glad to place at the disposal of the Conference any information or statistics in its possession, and to afford any other assistance in its power.

* * * * * *

First Meeting of the Agricultural Wages Board.

THE first meeting of the Agricultural Wages Board was held on 25th November at the Board's office at Gwydyr House Annexe, Whitehall, the Chairman, Lord Kenyon, presiding. The Minister of Agriculture, the Rt. Hon. Edward Wood, M.P., gave an address of welcome to the members, after which the Board adopted standing rules of procedure and considered various questions of administration. The Minister addressed the Board as follows :—

"Lord Kenyon, Mrs. Wintringham and Gentlemen, I think my first duty must be to thank Lord Kenyon, acting on your behalf, for having invited me to come to meet the Wages Board members to-day, and in so doing having given me the chance in that way of discharging my first official duty at the Ministry of Agriculture.

The new Agricultural Wages Board starts, I think, with a very favourable handicap. I think I am right in saying that out of 21 members something like 12 have had previous experience of the working of the old Board, and I think that you, Lord Kenyon, yourself were an appointed member on the old Board, and are therefore able to bring a great wealth of experience and knowledge to the new duties that you have been good enough to undertake.

The appointments to this body were made, of course, by my predecessor, who, if I may be permitted to say so, has exercised his power in that respect with wisdom and impartiality, and the appearance among your members of the leaders of the respective organisations concerned may be taken as evidence of the importance which those organisations attach to this form of collective bargaining. I think that among the eight members representing the National Farmers' Union, no less than three former Presidents and the present President find a place, and the same thing holds good with regard to the two Workers' Unions, who are represented by their Presidents and Secretaries as well as by my old friend and colleague, the veteran Mr. George Edwards. Therefore I think that a personnel of that strength shows good augury for the success of the work. Of course, Lord Kenyon, in any comparison that may be made between the present Wages Board and the old Wages Board, apart from personnel, there are two obvious differences that at once suggest themselves. The first is a difference to which reference has often been made which it is to-day not my purpose to discuss, and that is that of the original *tri-partite* policy, the original threefold policy, of the old Corn Production Act—the policy of guaranteed prices, wages regulations, control of cultivation—one part only remains under the present Wages Act. The second main difference is an important development for my present purpose, and that is the fact, of course, familiar to us all, that whereas under the old Wages Board the chief responsibility rested upon the Central Board, now these matters of wages and conditions of labour, or rather the responsibility for deciding these questions are deliberately thrown by Parlia-

ment on to the shoulders of Local Committees, with the assistance and guidance of appointed members, and of agreed or appointed Chairmen. That is an essential difference that gave rise to prolonged discussion in Parliament, and on which there was divergence of view. It is a difference which, I think, it is important that at the present time we should bear in mind, and I venture to express a very earnest hope, which is also an expectation, that both sides of the Wages Committees will realise their duties and will approach them with a determination to conduct them in an atmosphere of mutual conciliation and goodwill, and in that direction I think the Central Board can very largely help.

My party, the Conservative Party, was, of course, largely responsible for the change of the form of what is now the Act, it was then the Bill, in the respect which I have indicated, and in the end, as you will remember, that Bill was passed as agreed in substantial measure by all parties in the House of Commons, and the present Prime Minister has made it plain that it is the policy of our party to maintain it. I hope, therefore, that with the spirit of goodwill, with a desire to recognise each others difficulties, and perhaps no less important, with somewhat better agricultural prospects, that this machinery may be the means of securing such advance in wages as will raise the standard of agricultural labour without imposing greater burdens on the agricultural industry than under the present conditions it can bear.

Now the first few Committees that have begun to function have in every case provisionally agreed on rates that indicate a definite advance in wages, and it is worth remembering that since many of the lowest rates in force in different parts of the country were fixed there has been a definite improvement in agricultural prices. I am quite sure, from what I know of them, that farmers will not grudge labourers their full share of any increased prosperity that they themselves enjoy. It is, of course, in their own interest to pay as good wages as they can in order to retain the best men on the land, and to prevent them drifting off either to the towns or overseas. On the other hand I am sure that it will be the object of the workers' representatives no less to betray what I may call a reasonable spirit in negotiations, willingness to compromise, and that on both sides there will be a firm conviction that a shilling either way, if I may put it so, with goodwill, is worth more than a shilling to win with goodwill lost. Workers' representatives will also,

I have no doubt, remember that artificial elevation of wages is, of itself, no lasting benefit to workers if such wages are more than the industry can economically bear. But, first and last, the fundamental thing which I hope we shall all remember is that these two sides are partners in a common business, and that good relations are the foundation and the essential condition of prosperity.

The statutory functions of the Board arise in the first regard, of course, where there may be default in the operation of the local Wages Committees, and I hope, and I believe, that in that respect the duty which is thrown upon the Board will be light, but the Board's place in the general machinery is none the less, in my judgment, of very great importance. It is first of all a safeguard that the Act does operate everywhere, and in the second place, perhaps more important, it is easy to imagine that circumstances may often arise that will enable the Board to exercise a very valuable power of advising either Local Committees or the Minister on these questions of labour and wages. These questions are going to be considered by something like 46 or 47 separate Committees, and it is almost inevitable that in the course of that consideration there will arise common questions of general policy on which the Committees themselves, I suspect, will often be ready to seek and welcome advice and guidance from a Central Body acting in an advisory capacity as a co-ordinating instrument, and its help in that direction is likely to be of great value in achieving the objects that we look for.

Therefore, Mr. Chairman, I conclude by saying that even if members of the Board do not often have to fix direct rates of wages, and do not, therefore, for that purpose have to deliberate often, they yet have a great responsibility. Apart from the occasions when they will be consulted in an advisory capacity, the representative members on either side of the table are bound to be in a position to exercise great influence on their respective friends serving on the Local Committees throughout the country. The advice that they may have in their power and in their minds to give to their representatives on the Local Committees is often likely to make the difference whether this Act works smoothly or not, and therefore I am sure that the members of the Board will discharge their duties with a due sense of their importance, and that by conducting their own business with harmony, and by assisting, if harmony is lacking in any of the County Committees, towards its re-

introduction, they will be, I think, performing a most valuable service towards the attainment of the purpose that all those of us who seek to see the prosperity and the content and improvement in the agricultural industry, wish to see accomplished."

* * * * * *

Sugar Beet.

THE Government has decided to adopt and carry out the proposals made by the late Government for the grant of a subsidy for a period of ten years on a diminishing scale to sugar manufactured in this country from home-grown beet, coupled with a minimum price to the growers in the initial years.

The necessary measures have been prepared and will be presented to Parliament when it meets for business. It will not be possible to complete all the stages before Christmas, but it is the intention of the Government to secure their passage into law without any avoidable delay.

The proposed subsidy, which will apply to sugar manufactured during the current season, will be at the rate of 19s. 6d. per cwt. for the four years from 1924-25 to 1927-28 inclusive; at the rate of 13s. per cwt. for the three following years; and at the rate of 6s. 6d. per cwt. for the three final years. These rates will apply to sugar of a polarisation exceeding 98 degrees; for sugar of lower polarisations the rates will be reduced according to scale. The subsidy has been fixed at a rate which will enable the sugar factories to pay Excise Duty at the preferential rate, which at present is 9s. 8⅝d. per cwt., and the industry would not be adversely affected in future by any reduction in the Customs Duty on imported sugar, since the Excise Duty would be proportionately reduced at the same time.

It will be a condition of payment of the subsidy that the sugar manufacturers should pay during the first four years a minimum price of 44s. per ton of beet of 15½ per cent. sugar content, with an addition or reduction of 3d. per ton in respect of each one-tenth per cent. of sugar content above or below 15½ per cent.

The Government proposes also that in the case of any new sugar factories it shall be a condition of the payment of the subsidy that not less than 75 per cent. of the value of the machinery and plant shall be of British manufacture, unless the Minister of Agriculture for any special reason dispenses with this condition.

The Agricultural Index Number.

A FURTHER rise of 3 points in the index number of prices of agricultural produce, brings the general level of prices in October to 63 per cent. above that of the corresponding month in the years 1911 to 1913. This figure is the highest which has been reached this year and is, indeed, the highest since January, 1923. Between September and October last year prices fell from 56 to 51 per cent. above their pre-war level, due mainly to the sharp fall in hay prices, and to a less extent to lower prices for potatoes, fruit and vegetables. October prices are thus no less than 12 points higher than a year earlier, equivalent to an average rise of about 8 per cent. over the year.

The following table shows the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	59
September	202	116	57	56	60
October ...	194	86	59	51	63
November	193	79	62	53	—
December	184	76	59	56	—

Both wheat and oats show advances on the month, wheat averaging 12s. 6d. and oats 10s. 2d. per cwt. as compared with 12s. 1d. and 9s. 4d. respectively in September, while the corresponding index numbers have risen by 8 and 9 points respectively. Barley rose steadily during September, reaching its maximum at the end of that month and the beginning of October; the subsequent fall has been of about the same dimensions as the September rise, the October average, 17s. 3d. per cwt., showing no change from that of September. The index number, however, is a shade lower at 103 as against 107 per cent. above pre-war in the previous month, due to a slight advance at this period in the basic years.

Hay was a shade cheaper during October than in the previous month and, with pre-war prices showing a slight advance at this season, the index number has fallen 4 points. Potatoes, on the other hand, which usually tend towards lower prices at this season, rose substantially between September and October, averaging £9 3s. per ton at the wholesale markets as against

£7 7s. in September, while the rise of 55 points in the index number brings prices to two and a half times pre-war and is in no small degree responsible for the advance of 3 points in the general index number.

Fat cattle and sheep have fallen steadily during the past month, and the index numbers have declined by 6 and 7 points respectively, but pigs have to some extent continued their recent recovery, although the rise in price in October is confined to porkers. Relatively to pre-war prices pigs remain the cheapest kind of fat stock, although the difference between pigs and cattle is now much less pronounced than it has been for some time past, and the present level of pig prices, 40 per cent. above pre-war, is the highest since January.

Dairy cows have continued the advance which has been recorded each month since July, and at an average of £34 8s. per head were 27s. per head dearer in October than in September. Store cattle also showed an appreciable advance, but store sheep were slightly cheaper and, as a rise in price is usual at this time of year, the index number has declined substantially. Store pigs show no material change either actually or in relation to pre-war prices.

Winter milk prices came into operation on the 1st October, and the average price of milk delivered under contract to large towns advanced from slightly under 1s. per gallon in September to about 1s. 6d. per gallon in October. The index number has consequently risen by 23 points; this rise is not, of course, an indication of a sudden improvement in the position of the milk producer, but merely a result of the increased difference between the prices paid to milk producers for winter and summer milk. In pre-war contracts, winter prices were usually no more than 30 or 40 per cent. above summer prices, but in the post-war period the difference between summer and winter prices is in the neighbourhood of 50 per cent.

Butter and cheese were both fractionally dearer in October than in September, but as a rise is usual at this season, the advance is hardly reflected in the index numbers, cheese, in fact, showing a drop of 3 points. The seasonal advance in egg prices has been much more pronounced during the last two months than was usual before the war, and October prices were 89 per cent. above those in the corresponding month in the basic years, a rise of 26 points as compared with August.

The general index number would have risen by rather more than 3 points on the month but for a decided fall in the index number for fruit. Both apples and pears declined, each by

15 points, while the index number was still further reduced owing to the close of the plum season, since plums were relatively much dearer than other fruit. Fruit prices during October were only about 16 per cent. above their pre-war level, whereas in September the increase above pre-war had been 93 per cent. As against the fall in fruit prices, however, vegetables showed a slight rise, being 28 per cent. dearer than in October, 1911 to 1913, as against 19 per cent. in September; Brussels sprouts averaged 20 per cent., cabbage 8 per cent., cauliflowers 47 per cent., carrots (which declined appreciably during the month) 5 per cent., celery 50 per cent. and onions 38 per cent. above their price in the corresponding month in 1911 to 1913.

Index numbers of different commodities during recent months and in October, 1922 and 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1922.	1923.	1924.			
Commodity.	Oct.	Oct.	July.	Aug.	Sept.	Oct.
Wheat ...	24	20	47	59	61	69
Barley ...	29	25	52	75	107	103
Oats	33	25	28	38	38	47
Fat cattle ...	49	44	54	56	54	48
Fat sheep ...	90	76	97	100	100	93
Fat pigs ..	85	48	31	34	39	40
Dairy cows ...	69	61	55	57	59	62
Store cattle ...	30	27	51	48	38	41
Store sheep ...	106	99	132	129	130	112
Store pigs ...	135	82	28	29	29	29
Eggs... ...	104	92	65	63	71	89
Poultry ...	77	65	80	66	75	67
Milk	90	72	50	58	58	81
Butter ...	71	61	60	67	72	73
Cheese ...	36	76	90	66	42	39
Potatoes ...	3	62	81	72	99	154
Hay	45	7	1	3	1	-3*

* Decrease.

On the whole an examination of the index numbers this month shows that vegetable products have maintained the relative improvement in their position as compared with animal foods. Potatoes have advanced sharply, and are much the dearest of all agricultural produce as compared with pre-war prices, while barley comes second at rather over double the pre-war average. Wheat and oats have also risen appreciably, the only commodity in the vegetable group to be cheaper being hay. On the other hand, fat cattle and sheep, together with poultry, are cheaper, and pigs do little more than maintain their position, while the advance in milk prices this month is due, as has been stated above, to the post-war increase in the difference between winter and summer prices rather than to any sudden improvement in the position of the milk producer.

FEEDING FOR WINTER BEEF PRODUCTION.

T. B. WOOD, C.B.E., M.A., F.R.S.,

Drapers Professor of Agriculture and Director of the Animal Nutrition Research Institute, University of Cambridge.

THERE are two ways of describing such a subject as feeding for winter beef production. One method is to set out a number of typical rations which livestock owners may copy, and the other is to try to explain the fundamental principles of the subject and to show how from these principles those interested can work out rations to suit their own circumstances. Since there are about 300 different feeding stuffs in more or less common use which may be combined into rations in many hundreds of different ways, the first method does not seem promising. The writer has therefore adopted the second method, and has endeavoured to expound a system of calculation which should bring the compounding of satisfactory rations within the power of every stockowner. Whether he has succeeded or not experience will show. If he has not succeeded the fault is his.

In giving directions for working out rations for winter beef production the first thing which is necessary is to decide on the method of stating the food value of the various feeding stuffs which are in common use for the purpose. It is not enough simply to state their weight, for no one would maintain that a pound of hay, for instance, has the same food value as a pound of linseed cake, and everyone would agree that a pound of maize contains more nutriment than a pound of mangolds.

Starch Equivalent.—The real food value of a feeding stuff, especially for beef production, is best expressed in terms of starch equivalent. Starch equivalents as a measure of food value were introduced by the great German experimenter, Kellner, about 30 years ago. Kellner found by experiment that the addition of 1 lb. of starch to the basal ration of an adult bullock in store condition caused the animal to store in his carcass ¼ lb. of fat. He then found the amount of fat stored in the carcass of similar animals as a result of the addition to the same basal ration of known weights of other feeding stuffs. From these results he calculated the number of pounds of starch which would produce as much fat as 100 lb. of each feeding stuff, and these numbers he called the starch equivalents of the feeding stuffs. The starch equivalent of a feeding stuff is therefore the number of pounds of starch which would produce as much fat when fed

to a store bullock in addition to its basal ration as would be produced by 100 lb. of the said feeding stuff used under similar circumstances.

Thus the starch equivalent is a real measure of fat-producing power, and is therefore especially suitable for stating the real value of feeding stuffs for beef production, 1 lb. of starch equivalent being capable of producing ¼ lb. of fat.

Table III given on p. 808 shows the amount of starch equivalent in 100 lb. of many common feeding stuffs. More comprehensive tables will be found in "Rations for Livestock," which can be obtained from the Ministry.* This pamphlet gives the starch equivalents of about 300 feeding stuffs in the column headed "net digestible energy" (N.D.E.) which is another name for starch equivalent.

Other Characteristics of Feeding Stuffs.—In order to make the best use of a feeding stuff it is necessary to know two other things besides the starch equivalent—namely, the percentages of dry matter and of digestible protein. These are also given in the tables referred to on p. 808, and in the tables in "Rations for Livestock" referred to above.

It is also useful to know many other practical details, such, for instance, as the effect of a feeding stuff on the digestive organs—whether it is laxative or otherwise; also whether animals eat it readily or whether there will be trouble in getting them used to it. This kind of information is, however, better acquired by experience than by reading, and is usually well known by the stockowner.

In working out rations it is a great help to regard the ration as consisting of two parts. One part simply keeps the animal alive by providing the motive power for the ordinary vital functions, such as breathing, circulation of the blood and so on. This is called the *maintenance ration.* An animal on such a ration neither gains nor loses weight; it just "holds its own" as the farmer would say. The second part of the ration provides the material out of which the animal produces increase of live weight in the case of a bullock, milk in the case of a cow, or work in the case of a horse. Since it provides the material for production it is called the *production ration.*

The reason for considering these two parts of the total ration separately is that the amount of the maintenance ration varies with the size of the animal, while the amount of the production ration is independent of the animal's size but varies according to the result which the feeder desires to produce.

* Rations for Livestock, Misc. Pub. No. 32, price 6d., post free.

Maintenance Ration.—To deal first with the maintenance ration: this varies according to the animal's size, but unfortunately not in quite a simple way. The maintenance ration of a 14-cwt. animal is not nearly so much as twice the ration of a 7-cwt. animal. It is not easy to work out the maintenance ration by arithmetic, but it is quite easy to read it off at once from the Table I on p. 808, where it is given in terms of starch equivalent for animals of varying weights. The maintenance ration is usually given in the form of coarse fodder, such as hay or straw.

Production Ration.—The production ration is not quite so easy to calculate. It varies according to the result which the feeder desires to produce. The feeder will usually express his desires as so much live weight increase per day, which is by no means the same as so much fat stored per day. The chief constituents of live weight increase are water and fat. As an animal gets older, and especially as it gets fatter, its live weight increase contains less water and more fat. Now that part of the increase which consists of water does not require any starch equivalent for its production. Every pound of fat in the increase, however, requires 4 lb. of starch equivalent. It requires therefore more starch equivalent to make a pound of live weight increase in a full-grown fat animal than in a young lean animal.

The weights of starch equivalent required to produce 1 lb. of live weight increase in animals varying in age and condition are given in the Table II on p. 808. From these figures it is easy to calculate the production ration, in terms of starch equivalent, which will produce the rate of live weight increase which the feeder desires, or perhaps it is better to say of which the feeder considers his animals capable. Usually this will be a rate of about 2 lb. increase per day.

What is it which sets this limit to the rate of increase? It is the capacity of the digestive organs of the animal, or, in other words, its appetite. This is a somewhat variable quantity. It is best measured in terms of dry matter. Average figures for the amount of dry matter which animals of varying weight will eat are given in the tables.

It will be noticed that both maintenance ration and appetite or capacity vary with the weight of the animal. The feeder who wishes to work out a ration must therefore in some way ascertain the average weight of the animals for which the ration is designed. The best way of doing this is of course to weigh them. Although most farmers do not possess a weighbridge, it

is usually possible to get animals weighed when they are bought, either at the market or at the railway station. If this cannot be done, the alternative is to judge their live weight—a method which does not compare in reliability with actual weighing. It is also necessary to estimate the age and condition of the animals before the production ration can be calculated.

Calculation of Maintenance and Production Rations.—Having decided upon these figures, namely, (*a*) the average live weight, (*b*) the age, (*c*) the condition, of a lot of bullocks, the procedure for calculating the ration is as follows:—

(1) Ascertain from Table I the weight of starch equivalent required per head per day for maintenance.

(2) Calculate from this figure and the table of starch equivalents (Table III, col. 4) the daily ration of hay or straw required for maintenance.

(3) Decide on the anticipated rate of live weight increase.

(4) From the average age and condition of the animals find from Table II the weight of starch equivalent required to make 1 lb. of live weight increase.

(5) From (3) and (4) calculate the production ration in terms of starch equivalent.

(6) Calculate (from Table III, col. 4) the amount of feeding stuff, usually roots, required to supply this weight of starch equivalent.

(7) Calculate (from Table III, col. 3) the total amount of digestible protein contained in the sum of the maintenance and production rations, and subtract it from 1·5 lb., which is the weight of digestible protein required per day by a bullock of from 7 to 15 cwt. on a fattening ration.

(8) Calculate (from Table III, col. 3) the weight of concentrated feeding stuff, usually cake or meal, required to supply the deficiency of digestible protein.

(9) Decrease the weight of roots as calculated in (6) by 10 lb. for each pound of concentrated food as calculated in (8).

(10) Calculate (from Table III, col. 2) the total weight of dry matter in the combined ration and compare it with the capacity of the animals as given in Table I, col. 3.

(11) Make any necessary small changes in the ration as indicated by the comparison in (10).

TABLE I.

Live Weight.	*Starch Equivalent required for maintenance.*	*Capacity of appetite in terms of dry matter.*
cwt.	*lb.*	*lb.*
7	5·0	19
8	5·5	20½
9	6·0	22
10	6·5	23½
11	7·0	25
12	7·4	26½
13	7·8	28
14	8·1	29½
15	8·4	31

TABLE II. *Production Ration.*

Age. Years.	*Condition of Animals.*	*Weight of starch equivalent required to make 1 lb. increase.*
		lb.
About 1½	Forward stores	2
Under 2	Stores	2
About 2	"	2¼
Over 2	"	2½
2	Half fat	3
2	Nearly fat	4

TABLE III. *Composition of Feeding Stuffs.*

	Dry matter.	*Digestible Protein.*	*Starch equivalent*
	per cent.	*per cent.*	*per* 100 *lb.*
Meadow hay—very good ...	84	9·2	40
" " good	86	5·4	31
" " poor	86	3·4	20
Seeds hay—average	86	6·2	24
Oat straw	86	1·0	17
Barley straw	86	0·8	20
Swedes	11·5	1·1	7·3
Turnips	8·5	0·6	4·4
Mangolds—white fleshed ...	10·7	0·7	5·5
" red or yellow fleshed	13·1	0·7	6·8
Silage—average	30	2·8	12
Cotton cake, Bombay	88	16·0	40
" " decorticated ...	90	35·0	71
Ground nut cake, undecorticated	90	28·0	57
" " " decorticated	90	42·0	73
Linseed cake	89	25·0	74
Palm kernel cake	89	17·1	75
Soya bean cake	85	38·0	69
Maize meal	87	7·1	81
Maize germ meal...	89	10·4	65
Rice meal	91	7·5	72
Barley meal	85	6·5	71
Middlings	86	13·8	64

Any one possessing a fair working knowledge of arithmetic can work out balanced rations by following the above instruc-

tions. The instructions do not pretend, however, to replace the practical knowledge of the feeder, for which there is ample scope in selecting suitable animals, in judging their weight and condition, and in keeping a careful watch over the practical details of their housing, feeding and general management.

An example.—An example of working out rations will show the method better than further explanation.

Ration for a lot of 2-year-old store bullocks weighing on the average $8\frac{1}{2}$ cwt. to be ready for the butcher in 20 weeks.—Feeding stuffs available—barley straw, swedes, linseed cake and Bombay cotton cake. The procedure is as follows:—

(1) Table I. shows that animals weighing $8\frac{1}{2}$ cwt. require per day $5\frac{3}{4}$ lb. of starch equivalent for maintenance.

(2) The starch equivalent of barley straw per 100 lb. is 20; $5\frac{3}{4} \times 100 \div 20 = 29$ lb. will therefore be required for maintenance. This is an impossible amount, being beyond the capacity of the animal's appetite. Such animals will not eat more than about 14 lb. of straw per head per day unless forced to do so by hunger, in which case they would not fatten. This amount would supply $14 \times 20 \div 100 = 2{\cdot}8$ lb. of starch equivalent. It will therefore be necessary to supply the rest of the maintenance ration, namely, $5\frac{3}{4} - 2{\cdot}8 = 3$ lb. (nearly) in some other form, and of the feeding stuffs available swedes are the cheapest. Since 100 lb. of swedes contain 7·3 lb. of starch equivalent, 3 lb. will be contained in $3 \times 100 \div 7{\cdot}3 = 40$ lb. Maintenance requirements will therefore be satisfied by 14 lb. of straw and 40 lb. of swedes per head per day.

(3) The animals are to be fed from store condition to butcher's condition in 20 weeks, which means a rate of increase of 2 lb. live weight per head per day.

(4) Since the animals are 2 years old and in store condition they will require $2\frac{1}{4}$ lb. of starch equivalent to make 1 lb. of live weight increase. (Table II.)

(5) In order to make an increase of 2 lb. per day, their production ration must supply $4\frac{1}{2}$ lb. of starch equivalent per head per day. (This follows from (4).)

(6) The weight of swedes required to supply $4\frac{1}{2}$ lb. of starch equivalent is $4\frac{1}{2} \times 100 \div 7{\cdot}3 = 60$ lb. (Table III, col. 4.)

(7) The total ration will be 14 lb. of straw and 100 lb. of swedes. Straw contains 0·8 per cent. of digestible protein: 14 lb. will therefore contain about 0·1 lb. Swedes contain 1·1 per cent.: the total ration therefore supplies 1·2 lb., which, subtracted from 1·5 lb., leaves a deficiency of 0·3 lb. of digestible protein.

(8) The concentrated foods available are linseed cake containing 25 per cent. of digestible protein, and Bombay cotton cake containing 16 per cent. These are commonly used as a half-and-half mixture, which will contain almost exactly 20 per cent. of digestible protein. To supply 0·3 lb. of digestible protein $1\frac{1}{2}$ lb. of the mixed cake will suffice.

(9) This will take the place of about 15 lb. of swedes, by leaving out which the protein in the ration will be slightly reduced.

It will be advisable therefore to use 2 lb. of the cake mixture, decreasing the root ration by 20 lb.

(10) From the tables it is easy to calculate the weights of dry matter, starch equivalent and digestible protein in the total ration, thus:—

14 lb. straw contains	12 lb. dry matter,	2·8 lb. S.E.,	0·1 lb. dig. protein.
80 lb. swedes "	9 " " "	5·8 " "	0·9 " " "
2 lb. cake "	1·8 " " "	1·1 " "	0·4 " " "
Total ration contains	22·8 " " "	9·7 " "	1·4 " " "

These figures are near enough to the correct amounts.

The total dry matter is about 1 lb. more than average 8½ cwt. stores will eat, the starch equivalent is ½ lb. under the combined requirements for maintenance and production as worked out separately above, and the protein is 0·1 lb. below the standard of 1·5 lb., which, however, is very ample.

(11) No further adjustment is necessary. The animals will make the necessary small adjustments for themselves if their straw is given to them in the form of an abundant supply of long straw. From this they will pick out the softer leafy parts and especially any clover—which is commonly present in barley straw, and leaves of straw and clover are more digestible and contain more digestible protein and starch equivalent in less bulk than whole straw. The tougher portions of the straw will be trodden down for litter. The roots will usually be given as two bushels of pulped roots, which will weigh rather more than 80 lb. The cakes, however, should be actually served out by weight.

At starting on this ration the thrifty stores should make gains of about 2 lb. per head per day, and should maintain this rate of increase for 12 weeks or thereabouts. During this period they will increase in weight from 8½ cwt. to about 10 cwt. This increase will in the first place raise their maintenance requirements from 5¾ lb. of starch equivalent per head per day to 6½ lb. This will be partly satisfied by increased consumption of straw if they are given an abundant supply of long straw, but their root ration should also be increased to the maximum quantity they will eat.

In the second place, the live weight increase will be accompanied by fattening, and as fattening proceeds the amount of starch equivalent required to add each successive pound of live weight continuously increases, so that by the time the animals in question reach 10 cwt. they will require at least 6 lb. of starch equivalent to maintain a rate of increase of 2 lb. per day. To some extent they will be able to make up for this by consuming more roots, but both straw and roots are bulky and an animal's capacity for food is not unlimited. If the rate of

increase is to be maintained for a further period it is therefore necessary to increase the concentrated food in the ration. The increase need not take the form of cake as there is no need to increase the protein. The best kind of concentrated supplement for the later stages of fattening is some kind of cereal comparatively poor in protein, but containing the maximum of starch equivalent in the least possible bulk. Maize meal, maize germ meal, rice meal, barley meal or crushed barley, and middlings are all suitable for the purpose.

Some such ration as the following will maintain the rate of increase for a further period :—

	Dry Matter. *lb.*	*Starch Equivalent.* *lb.*	*Digestible Protein.* *lb.*
14 lb. straw	12	2·8	0·1
100 lb. swedes	11·5	7·3	1·1
2 lb. cake as before	1·8	1·1	0·4
1½ lb. maize meal	1·3	1·2	0·1
	26·6	12·4	1·7

Even on this ration the rate of increase will fall off before the end of the 20 weeks, because as the weight of the animals rises not only will their maintenance requirements increase but by the time they approach prime fatness they will require as much as 8 lb. of starch equivalent to make 2 lb. daily gain, and this is more than they can eat if their ration includes any quantity of so bulky a food as straw, which contains only one-fifth of its weight of starch equivalent. Ordinarily it is not an economic proposition to make a further increase in the concentrated ration. Such a ration as that given above will finish off animals to a good saleable condition, even though in the last stages they make only small gains in live weight. If, however, for special reasons an extreme degree of fatness is desired, this can readily be attained by increasing the cereal in the concentrated ration, when the animals will discard some of their straw in favour of the more palatable addition. For extreme fattening of this kind, the problem is to get as much starch equivalent as possible, regardless of cost, into the capacity of the animal's appetite. Perhaps the feeding stuff most suitable for this purpose is one of the proprietary brands of cooked flaked maize. Such feeding, however, is only to be justified for purposes of exhibition or advertisement.

Concentrates.—The above example will have illustrated the method of working out rations for winter beef production where

the main constituents of the ration are straw and roots. The same method can be followed for working out rations for all kinds of conditions, and will give reliable results. Only one point remains, the choice of concentrated foods to supplement the straw, hay, roots, etc. Linseed cake and cotton cake were taken in the example worked out because they are so widely used. Almost any cake or mixture of cakes can be used, and choice should vary in accordance with prices—not, however, prices per ton, but prices per unit of starch equivalent. These prices are given every month in the table at the end of "Notes on Feeding Stuffs" in this *Journal*. At the present time the cheapest suitable concentrated feeding stuffs are decorticated ground nut cake and rice meal. A half-and-half mixture of these contains as much digestible protein and starch equivalent in $1\frac{1}{2}$ lb. as there is in 2 lb. of mixed linseed and cotton cake, and is considerably cheaper.

* * * *

FARM WORKERS' BUDGETS.

I.—PRICES AND COST OF LIVING.

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THE only general inquiries into the cost of living of farm workers which have been made are those of 1902 and 1918, made by Mr. Wilson Fox* and by the Agricultural Wages Board respectively, but after careful examination of all the information available the Cost of Living Committee of the Agricultural Wages Board in 1918 arrived at an estimated expenditure on foodstuffs in 1912.† Thus there are three records of expenditure of farm workers, one for 1902, one for 1912, and one for 1918, which are more or less generally accepted. Other investigations have been made privately, but they were either restricted to special areas or to families in special circumstances, and their results cannot generally be accepted as representative of normal conditions at the time they were made.

Further, the last official inquiry, in 1918, was made under war conditions; in particular, purchases of certain commodities were restricted and the prices of many commodities were legally controlled. Consequently, the record of expenditure at that time cannot be regarded as in any way applicable to normal conditions.

* Second Report on Wages, Earnings and Conditions of Employment of Agricultural Labourers. Cmd. 2376, 1905.

† Report of the Committee appointed by the Agricultural Wages Board, to inquire into the Financial Results of the Occupation of Agricultural Land and the Cost of Living of Rural Workers. Cmd. 76.

Moreover, no official record of actual retail prices ruling in small towns or villages is now available, for the Ministry of Labour gives only percentage increases since 1914. As a result there is little current information on the commodities purchased by farm workers or the retail prices of them.

Retail Prices of Foods.—It is possible, however, to get some information about the retail prices which are charged in shops, etc., in small towns and villages, and the following list has been extracted from budgets collected and loaned by the National Union of Agricultural Workers, checked by information from other sources. The prices are in some cases influenced by the small quantities which are bought, and also by the varying qualities, but in nearly every case in which the quotations are fairly numerous there is a normal range which corresponds fairly closely with the average.

Table I.—Prices of Goods Purchased by Farm Workers. March, 1924.

Commodity and Unit.		No. of Quotations.	Lowest.		Highest.		Average.	
			s.	d.	s.	d.	s.	d.
Foodstuffs.								
Bread	4 lb.	20		7		9		8
Flour	7 ,,	33	1	1	1	9	1	4
Rolled Oats	lb.	5		2½		4½		3½
Rice	,,	14		3		6		4
Bacon	,,	14		10½	1	3	1	1
Fresh Butcher's Meat	,,	20		7	1	6	1	0¾
Suet	,,	1	1	2	1	2	1	2
Lard	,,	30		9	1	0		10¼
Dripping	,,	1	1	0	1	0	1	0
Margarine	,,	34		6	1	2		9½
Butter	,,	15	2	0	2	4	2	1¼
Cheese	,,	30	1	0	1	6	1	2½
Currants	,,	20		6		10		8½
Raisins	,,	5		8		9		8½
Jam	,,	16		8	1	2		9¾
Syrup or Treacle ...	,,	6		3		8½		6¾
Sugar	,,	37		6¼		7½		7
Tea	,,	40	1	10	3	0	2	6½
Coffee	,,	—	—		—		—	
Cocoa	,,	12	1	2	2	6	2	0¾
Milk, new	pint	22		2		4		2¾
,, skimmed ...	,,	5		1		2		1
Fuel and Light.								
Coal	cwt.	33	1	10½	2	10	2	6¼
Oil	gallon.	24	1	0	1	4	1	0½
Candles	lb.	11		2		9		5¼
Matches	doz.	11		8	1	0		10¾
Soap	lb.	17		6		8		6½

As a comparison of prices of foodstuffs purchased by farm workers at different dates was made by the Cost of Living Committee of the Agricultural Wages Board, this has been continued in Table II. This gives prices of certain foodstuffs in January,

1914 and 1918, and in March, 1924. The prices for 1924 show increases over those ruling in 1914 ranging from 4 per cent. in the case of bacon to 211 per cent. in the case of sugar. They show changes from the prices ruling in January, 1918, ranging between increases of 9 per cent. in the case of flour and 22 per cent. in the case of sugar, and decreases of 49 per cent. in the case of bacon and 53 per cent. in the case of dried fruit. Sugar and flour are the only commodities which have increased in price since 1918, and most other commodities show a fairly substantial decrease.

Table II.—Average Prices and Increases or Decreases in Prices of Foodstuffs, 1914-1918-1924.

Commodity and Unit.		1914 (January). Average.	1918 (January). Average.	1924 (March). Average.	Increase or Decrease (—) in Average Prices. 1918 over 1914.	1924 over 1914.	1923 over 1918.
		s. d.	s. d.	s. d.	per cent.	per cent.	per cent.
Bread	4 lb.	6	8¾	8	45	33	— 9
Flour	14 ,,	1 9¼	2 5	2 8	36	51	10
Oatmeal or Quaker Oats	lb.	2¾	4½	3½	63	27	—22
Bacon	,,	1 0½	2 1½	1 1	104	4	—49
Beef	,,	10¼	1 6¼	1 0¾	78	24	—30
Butter	,,	1 4	2 6	2 1¼	87	58	—16
Cheese	,,	9	1 4	1 2½	77	61	— 9
Milk	pint	1¾	2¾	2¾	57	57	No change
Margarine ...	lb.	8¾	1 0	9½	37	9	—21
Lard	,,	7¾	1 6½	10¼	138	32	—45
Dripping ...	,,	6½	1 4¾	1 0	157	85	—28
Suet	,,	8½	1 4¾	1 2	97	65	—16
Currants	,,	4½	1 6¼	8½	305	89	—53
Jam	,,	5½	10¼	9¾	86	77	— 5
Rice and Tapioca	,,	2¾	5¾	4	109	64	—30
Sugar	,,	2¼	5¾	7	155	211	22
Tea	¼ lb.	5½	8¼	7½	50	36	— 9
Cocoa	,,	5¾	8¼	6¼	43	9	—24

No method of weighting the retail prices of various goods to obtain a measure of changes in the cost of living of farm workers has been developed, except that of pricing a budget. Even this is a somewhat limited method, for its use is restricted mainly to measurement of changes in cost of foodstuffs. It is possible to get information on expenditure in the purchase of fuel and lighting materials and some other household requirements which are purchased weekly, but it has never previously been possible to get reliable information on actual expenditure on clothing and some other requirements which are purchased at longer intervals.

However, the actual record of quantities of foodstuffs purchased in 1902 and the estimate of quantities purchased in 1912 are available, and these can be priced at the figures ruling in 1923.

This has been done in Table III. The reason why the 1918 record of foodstuffs purchased has not been similarly used is that the conditions of supply and purchase in that year were such as to cause a considerable "scatter" of purchases, when all sorts of purchases were made and many in such small quantities that it is impossible to price them with anything like accuracy. Moreover, there is every indication that the character of present purchases approaches more nearly to that of 1912 than to that of 1918.

Cost of Food for a Family of Six.—The cost of foodstuffs purchased for a family of six persons (two adults and four children) in 1902 was 13s. 7½d. per week. In 1923 the cost of the same quantities of foodstuffs would be 28s. 1d. per week. With the changed quantities and the changed prices of the estimate for 1912, the cost of foodstuffs was 15s. 5d. per week, and the quantities of 1912 at 1924 prices would cost 27s. 7d. per week. Thus basing the comparison on 1912 alone, the increase is from 15s. 5d. to 27s. 7d., or 78 per cent. The increase in retail prices of foodstuffs in small towns and villages given by the Ministry of Labour for January, 1924, was 74 per cent. above those of July, 1914. There is thus fairly close agreement between the figures of the Ministry of Labour and those obtained by pricing the budget of 1912.

It is, however, obvious that with wages of farm workers averaging about 28s. per week in the early part of this year, the normal family could not be spending 27s. 7d. on foodstuffs, and that changes in consumption must have taken place. At the same time, it must be remembered that these changes in consumption mean a definite lowering of the standard of living. The quantities of goods recorded as purchased in 1902, and the somewhat smaller quantities of 1912, only yielded about sufficient nutritive values on the accepted standards of dietetic requirements for a family of the size to which the budgets applied (see Table III).

II.—BUDGETS IN 1924.

Forty-nine Budgets.—In addition to this information on prices some information on current expenditure became available through the collection of between sixty and seventy budgets by the National Union of Agricultural Workers. These were collected in February and March, but mainly in March, of 1924, and were critically examined by both the writer and an assistant. After exclusion of a number for various reasons, 49 of them were tabulated. The chief reasons for exclusion were either that the

Table III.—Changes in Cost of Foodstuffs on Basis of 1902 and 1912 Budgets.

Article and quantity to which price applies.		Foodstuffs—1902 Budget. Average quantity consumed in 1902.	Price. 1902.	Price. 1924.	Aproximate Cost. 1902.	Aproximate Cost. 1924.	Foodstuffs—1912 Budget. Average quantity consumed in 1912.	Price. 1912.	Price. 1924.	Approximate Cost. 1912.	Approximate Cost. 1924.
		lb.	s. d.	s. d.	d.	d.	lb.	s. d.	s. d.	pence.	pence.
Beef or Mutton - - - -	lb.	3.35	7¼	11	24.43	36.85	3.35	8	11	26.80	36.85
Pork - - - - - -	,,	1.10	8	1 3	8.80	16.50	1.10	8½	1 3	9.35	16.50
Bacon - - - - -	,,	2.70	6	1 4¾	16.20	45.22	2.08	10	1 4¾	20.80	34.84
Cheese - - - - -	,,	1.20	6½	1 3¼	7.80	18.30	1.08	8	1 3¼	8.64	16.47
Bread - - - - -	4 lb.	19.20	4½	8½	21.93	40.80	19.89	5½	8½	27.35	42.26
Flour - - - - -	14 ,,	14.87	1 5½	2 5½	18.58	31.33	15.17	1 8	2 5½	21.67	31.96
Potatoes - - - - -	,, ,,	25.75	6	1 4½	11.07	30 39	25.75	7	1 4½	12.87	30.39
Rice and Oatmeal - - -	lb.	1.25	2	3	2.50	3.75	1.56	2	3	3.12	4.68
Tea - - - - - -	,,	0.46	1 4	2 6½	7.36	14.03	0.51	1 4	2 6½	8.02	15.55
Coffee and Cocoa - - - -	,,	0.15	11½	2 6	1.85	4.50	0.15	1 0	2 6	1.80	4.50
Butter - - - - - -	,,	1.04	1 2	2 1¾	14.65	26.78	1.04	1 2	2 1¾	14.65	26.78
Lard, Dripping and Margarine	,,	1.03	6	6¾	6.18	6.95	1.03	7	6¾	7.21	6.95
Sugar - - - - - -	,,	4.31	2	6¾	8.62	29.09	4.57	2	6¾	9.14	30.85
Treacle, Syrup and Jam -	,,	1.61	4	1 0	6.44	19.32	1.61	4¾	1 0	6.65	19.32
Milk, new - - - - -	pint	4½*	1½	3	6.75	13.50	4½*	1½	3	6.75	13.50
TOTAL - - -		- -	- -	- -	13s. 7¼d.	28s. 1¼d.	- -	- -	- -	15s. 4¾d.	27s. 7½d.

* Pints.

budgets contained too little detail to enable a judgment on their accuracy to be made, or that attempts had been made by the persons responsible for them to supply "representative" or "average" statements. In one or two cases the individual budgets were evidently not those of farm workers' families.

Some difficulties were met with in dealing with the remainder. These were chiefly concerned with the confusion which arises out of the term groceries, which frequently includes many household commodities besides foodstuffs. Thus of the 49 families dealt with only 36 made any return of cleaning materials such as soap, soda, etc. Most of these had an inclusive term "groceries" for considerable expenditure, which almost certainly covered the "cleaning materials" purchased.

In addition, 13 of the families failed to mention any payments for insurances, even though 5d. per week is now the statutory contribution to the National Health Insurance Scheme general amongst farm workers. It is possible that this was not included because it was regarded as sufficiently well known without repetition. In any case, it would have to be paid, and there are very few cases in which the whole charge is met by the employer—certainly not to the proportion of 13 cases in 49.

Of the 49 budgets which have been tabulated particulars of the families concerned are given in 40 cases and omitted in 9 cases. These two groups have been treated separately.

Forty Budgets with Particulars of Families.—After making the necessary adjustments for lack of record of expenditure on cleaning materials and insurances in the cases mentioned, the itemised expenditure for 40 families is as follows:—

Table IV.—Expenditure of 40 Families.

Items.	Expenditure.					Adjusted Expenditure.					Average on 40 cases.	
	Total.		No. of occurrences.	Average.		Total.		No. of occurrences.	Average.			
	s.	d.		s.	d.	s.	d.		s.	d.	s.	d.
Rent	85	2½	32	2	8	.	2½	32	2	8	2	1¼
Foodstuffs ...	772	6*	40	19	3¾	**759**	**7**	**40**	**18**	**11¾**	18	11¾
Cleaning Materials	24	1½	29		10	**33**	**4**	**40**		**10**		10
Insurance ...	35	5	31	1	1¼	**39**	**2**	**40**		**11¾**		11¾
Clothing	17	5½	9	1	11¼	17	5½	9	1	11¼		5¼
Fuel and Lighting	177	7	40	4	5	177	7	40	4	5	4	5
Any Other ...	12	7½	15		10	12	7½	15		10		3¾
Total ...	1124	11	40	28	1½	1124	11	40	—		28	0¾

* Including other items in "groceries."

The first column of this table shows the actual total of expenditure, but in the distribution of itemised expenditure after the

first columns there is a small element of estimating. This is not important, for when the estimated amount per family on foodstuffs is compared with that item in the first column, where the figure includes other groceries, etc., the difference is only one of 4d., viz., between 19s. 3¾d. and 18s. 11¾d. The rent paid cannot properly be distributed over the whole of the families, for eight did not pay rent, as they live in rent-free or "tied" cottages, but it has been averaged to show the average distribution of the money income of the whole group of families.

The expenditure is a little in excess of the stated wages of the families for the weeks to which the budgets apply, for the total wages of the men who were heads of families amounted to only 954s. 4d. against expenditure of 1,124s. 11d. This, however, does not imply inaccuracy, because there are more people in employment than families. Yet not all wages are stated, and it has been common experience that budgetary inquiries fail to elicit all sources of family incomes. For instance, a son living at home may earn £1 a week and pay for board 12s. or 15s. when only this amount and not the total earnings are included in the statement. Moreover, there is always the possibility of one or more families amongst fifty being in any given week in the course of running up debts. With an average wage of 27s. 3d. per head of family, and an average expenditure of 28s. 1½d. there can be little cause for doubt of general accuracy.

The families were composed as follows:—

	Total.	Per Family.
Adults ...	85	2.125
Children ...	152	3.800
Total ...	237	5.925

Thus with nearly six persons per family, equal to 3.8 men for dietary purposes, the average family here coincides almost exactly with the average family as found in 1902 and in 1918. The sum spent on food per head was about 3s. 2d., or exactly 5s. per "man."

Nine Budgets without Particulars of Families.—For the nine remaining families, for which no particulars of the constitution of the families were given, the following are the figures. On these nothing need be said, except that the necessary adjustments have been made as before. The results are a little different from those of the larger group, but they are not sufficiently different to call for special comment. It is, however, probable that the families are rather smaller in this group than in the larger group for which family particulars were given.

Table V.—Expenditure of Nine Families.

Items.	Expenditure.			Adjusted Expenditure.			Average over 9 cases.
	Total.	No. of cases.	Average.	Expenditure.	No. of cases.	Average.	
	s. d.		s. d.	s. d.		s. d.	s. d.
Rent	15 11	5	3 2	15 11	5	3 2	1 9¼
Foodstuffs ..	180 1½*	9	20 0	**176 6½**	**9**	**19 7½**	19 7½
Cleaning Materials	6 7	7	11½	**8 6**	**9**	**11½**	.. 11½
Insurances .	7 7½	5	1 6	**9 3½**	**9**	**1 0½**	1 0½
Clothing	—	—	—	—	—	—	—
Fuel and Lighting	34 8½	9	3 10¼	34 8½	9	3 10¼	3 10¼
Other Expenditure	1 10½	2	11¼	1 10½	2	11¼	2¼
Total ...	246 10	9	27 5	246 10	—	—	27 5¼

* Including other items in "groceries."

The average wages for the heads of these families were 26s. 3d. per week, so that the expenditure was in excess of the earnings of the heads of families. But again, it is probable that other persons were earning wages in addition to those earned by the fathers of the families.

Budgets for Small Families.—In order to discover if any differences in expenditure occurred as a consequence of a large or a small number of children per family, the 40 budgets which gave particulars of the family were divided into two groups (Table VI and VII). The first group, of 18 budgets, consists of families with three children or less. The second, of 22 budgets, consists of families each having more than three children.

Table VI.—Eighteen Families with 3 Children or less.

Items.	Expenditure.			Adjusted Expenditure.			Average of cases.
	Total.	No. of Cases.	Average.	Total.	No. of Cases.	Average.	
	s. d.		s. d.	s. d.		s. d.	s. d.
Rent	40 1	14	2 10¼	40 1	14	2 10¼	2 3
Foodstuffs ...	324 3½*	18	18 0¼	**318 9¼**	**18**	**17 8½**	17 8½
Cleaning Materials	10 1	13	9¼	**13 10¼**	**18**	**9½**	9½
Insurances ...	17 11½	14	1 3¼	**19 7½**	**18**	**1 1**	1 1
Clothing	6 5½	4	1 7½	6 5½	4	1 7½	4½
Fuel and Lighting	77 9	18	4 3¾	77 9	18	4 3¾	4 3¾
Other Expenditure	5 5½	7	9¼	5 5½	7	9¼	3¾
Total Expenditure	482 1	18	26 9¼	482 0	—	—	26 10

* Including other items in "groceries."

Again the itemised expenditure after the first column as been adjusted to distribute the expenditure between that on foodstuffs, cleaning materials and insurances, over all the families. The number of persons in these families was as follows:—

		Total.		Per Family.
Adults	...	36	...	2.00
Children	...	46	...	2.55
Persons	...	82	...	4.55

These 4.5 persons represent almost exactly three men (3.075) for dietary purposes. The average expenditure on foodstuffs represents 3s. 11½d. per person or 5s. 11d. per "man." Thus the expenditure on food per head is higher, as would be expected, in the case of the smaller than in the case of the average families.

Budgets for the Larger Families.—The expenditure for the 22 families with more than three children is given below (Table VII). The itemised expenditure has again been adjusted to distribute expenditure on cleaning materials and insurances over all families, but differences between the first and second sets of figures are small.

Table VII.—Twenty-two Families with more than 3 Children.

Items.	Expenditure.					Adjusted Expenditure.					Average of 22 cases.	
	Total.		No. of Cases.	Average.		Total.		No. of Cases.	Average.			
	s.	d.		s.	d.	s.	d.		s.	d.	s.	d.
Rent	45	1½	18	2	6	45	1½	18	2	6	2	0½
Foodstuffs ...	448	2½*	22	20	4½	**440**	**10**	**22**	**20**	**0½**	20	0½
Cleaning Materials	14	0½	16		0½	**19**	**3½**	**22**		**10½**		10½
Insurances ...	17	5½	17	1	0¼	**19**	**6½**	**22**		**10**		10¾
Clothing	11	0	5	2	2½	11	0	5	2	2½		5
Fuel	99	10	22	4	6½	99	10	22	4	6½	4	6½
Other Expenditure	7	2	8		10¾	7	2	8		10¾		4
Total ...	642	10	22	29	2½	642	10	—	—		29	1¾

* Including other items in "groceries."

The number of persons in this group of the largest families was :—

		Total.		Per Family.
Adults	...	49	...	2.23
Children	...	106	...	4.82
Persons	...	155	...	7.00

These families are large, both as regards the number of persons and as regards their dietary requirements, for the average family represents about 4.4 men as compared with 3.8 men for the average of the whole 40 families. The expenditure on food is very low, for it represents only 2s. 10d. per person, or 4s. 6½d. per "man." The other items vary very little with the size of the families, although that on fuel is a little heavier in the case of large than in that of smaller families. On the whole this set of budgets shows, as most budgets do, that the larger families tend to reduce their relative expenditure on foodstuffs.

There is no reason to doubt the general accuracy of these budgets, although as regards some details the records left much to be desired. The chief criticism against the group of budgets as a whole is that it includes too many families of a comparatively large size, and that the counties in which low wages prevailed at the time of collection were heavily represented. It was not, however, due to any conscious bias in collection that low-wages counties contributed rather more than their quota to the whole group, for it so happens that in these counties wages are more largely paid in cash week by week, and it is therefore easier for workers to state their weekly expenditures than in counties in which other systems of wage payment prevail.

(To be continued.)

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THE WORKING OF THE SEEDS ACT, 1920, DURING THE SEASON, 1923-24.

DURING the season 1923-24 the system of intensive inspection work in connection with the administration of the Seeds Act, 1920, has been slightly modified to the extent that the number of advisory visits to seedsmen's premises has been reduced, the total of such visits having been 6,500 as compared with 9,000 in the previous season. It is believed that the majority of seedsmen are now fully aware of the requirements of the Act and Regulations, and with comparatively few exceptions are carrying them out to the best of their ability. In these circumstances it is obviously unnecessary and undesirable, both from the point of view of the Ministry and that of the seed trade, to continue the system of intensive advisory visits which had been in operation since the first seed testing Order was passed.

As in every other trade, there are a certain number of men in the seed trade who endeavour to evade their legal responsibilities in order to serve their own ends, but these men are being closely watched and prompt action is taken immediately a definite breach of the regulations can be brought home to them. There is also the class of tradesman who sells seeds as a " side line " to his usual business. In most of these cases his knowledge of seeds is extremely limited, and, as he offers seeds for sale during a very limited period of the year, he presents somewhat of a problem in connection with the administration of the regulations. Fortunately a large and increasing proportion of these men sell their seeds in packets, and as the wholesale trade in packet seed is being driven more and more into the hands of a comparatively few reputable firms who are fully alive to

their legal responsibilities, and who realise that it is in their own interests to secure that their retailers sell seed of high quality only, it is hoped that in time the problem of the "side line" seller will solve itself.

Farmer to Farmer Sales.—A more urgent problem than that presented by the "side line" seller is that of the farmer seller. It is a well-known fact that large quantities of seeds are sold from farmer to farmer, and it is a difficult matter to bring home to the selling farmer his responsibilities and to the buyer the risk he runs of purchasing seed of low germination and containing a serious proportion of weed seeds. Amongst the various efforts to tackle this problem which have been made during the past season, special visits have been paid by Inspectors to a large number of farms for the purpose of discussing the requirements and advantages of the Seeds Act and Regulations, and of taking informal samples of seeds for purposes of investigation. A great deal of good has resulted from these visits, but objection to them can be raised because of the amount of time they take and the travelling expenses involved. Unfortunately it was not found possible to take as many investigational samples of seeds on the farms visited as was hoped, but the results of the tests on those taken show clearly the difference in the quality of the seeds purchased from the reputable seedsman and those purchased from a neighbouring farmer or saved by the farmer from his own crops. One very useful means of bringing the Seeds Regulations to the notice of farmers is through the advertisements offering seeds for sale which appear in the local press. These are carefully watched and followed up by letter or, if necessary, by a visit.

Seeds Exhibit at Agricultural Shows, &c.—It is believed that the most economical and satisfactory method of getting into touch with the farmer is achieved by qualified Inspectors attending Agricultural Shows, Corn Exchanges and Markets with a small exhibit designed to illustrate graphically the usefulness of the Seeds Act. Several of these exhibits are now in use, and a large number of shows and markets have been attended during the past season with very encouraging results. The practice of delivering lectures on the Seeds Regulations at meetings of farmers' associations is also being developed.

Control Sampling.—With a reduction in the number of advisory visits to premises where seeds are sold, it is possible and desirable somewhat to increase the visits paid for the purpose of drawing control samples. During the season some 613 such

samples have been taken, including 165 samples of clovers, 90 of grasses, 84 of root seeds, 263 of vegetable seeds (apart from seeds sold in packets), and 11 of cereal seeds. Of these, 57 samples showed, as a result of the check test at the Official Station, that the declaration made by the sellers was incorrect in a material particular. In 16 cases the germination differed by from 10 to 15 per cent., 8 differed by from 15 to 20 per cent., and in 12 cases the germination figure was more than 20 per cent. out. The purity figure was wrong to the extent of from 3 to 5 per cent. in 8 cases, from 5 to 10 per cent. in 5 cases, and over 10 per cent. in 3 cases. In the other 5 cases either the dodder or injurious weed seed content was not stated. Taken as a percentage of the total number of control samples it will be seen that the discrepancy cases amount to 9 per cent. This is, of course, far from satisfactory, but it shows an improvement on the 1922-23 season when the discrepancy cases amounted to 11·5 per cent. of the total number of control samples taken.

Packet Seed.—Further improvement in the quality of seeds sold in packets is indicated by the fact that of the 292 samples of packeted seed taken during the season 90·6 per cent. were found to be above the minimum standards laid down in the Regulations, 2·4 per cent. were below these standards but above two-thirds, and 7 per cent. were below two-thirds of the standards.

Licensed Private Seed Testing Stations.—The total number of private stations in England and Wales licensed to test seed for the purposes of the Act is now 86, and includes 28 to test all kinds of seeds covered by the Act, 3 to test all seeds with the exception of grasses, 8 to test field and cereal seeds, 5 to test field seeds, 35 to test cereals, 5 to test cereals, peas, beans, tares and crucifers, and 2 to test cereals and beans.

In order to check the results of tests carried out at licensed stations the Ministry has taken from these establishments, during the past season, some 779 special samples, as compared with 670 in 1922-1923. Discrepancies were found in 17.5 per cent. compared with 20 per cent. in 1922-1923—a slight improvement. Taking each group of seeds separately the following points are brought out as a result of the check tests on these special samples carried out at the Official Station:—

Cereals.—242 samples were tested; in 24 there were discrepancies, 15 being samples of oats, and in practicably all those cases the discrepancy was due to the samples not being "germinating ripe," at the time of testing by the licensed

station. The period between the two tests and the condition of storage was sufficient to account for the improvement in the resulting test.

Clovers.—128 samples of red, white or alsike clovers were examined, and the discrepancies were 12 in respect of germination, 15 in respect of purity, and 2 in respect of both purity and germination—a total of 29.

Fifty-five samples of trefoil and trifolium were examined, and discrepancies were reported in 14 cases—3 in respect of purity, and 11 in respect of germination.

Grasses.—83 samples of grasses were taken for testing, 60 being Italian or perennial ryegrass; 6 ryegrass samples showed discrepancies—5 of these being cases in which the purity statement was too high. There were not enough of any other species of grasses to make comment of any value.

Field Seeds.—150 samples were taken. In this group mangolds, including here sugar beet, were the only seeds which showed any marked differences. Out of 57 samples, 20 showed variation. In most cases the Official Seed Testing Station test showed a higher germination figure that did the test made by the licensed stations, this difference being almost entirely due to the better facilities which exist at the Official Station for regulating the alternations of temperature required with this class of seed.

Vegetable Seeds.—97 samples of vegetable seeds were taken. This number is too low to admit of conclusions, but the few samples that were tested showed very poor results, no less than 25 per cent. of the samples giving variations outside the limits of error.

Referee Samples.—As a further means of securing a higher degree of unformity in the results of tests carried out at the Official Stations and the various private licensed stations, a series of " referee " samples have been issued for testing during the past season. These included samples of ryegrass (sent to 30 stations), trefoil (34 stations), cocksfoot (30 stations), wild white clover (35 stations), alsike (35 stations), red clover (35 stations), beet (31 stations), mangolds (46 stations), and tares (50 stations). The results of these various tests were dicussed in detail at a recent conference of seed analysts held at the Official Seed Testing Station, Cambridge, when many interesting and useful points were brought out. The results obtained by the licensed stations, as compared with the English, Scottish, North Irish and in some cases the Danish Official Stations, varied with the

difficulty of the sample. The closest results were obtained with the trefoil; the greatest differences occurred with cocksfoot. The reasons for the variation in results were carefully examined at the conference mentioned, and it is believed that this will lead to a much greater uniformity in methods and results as between the various stations.

Training and Examination of Seed Analysts at the Official Seed Testing Station.—A very successful course of training of seed analysts was held during the summer at the Official Seed Testing Station, Cambridge, analysts attending and displaying great keenness in the work. This is the third annual course which has been held at the Official Station. At the close of the course an examination was held, which was passed by 13 of the 16 candidates who sat.

Fourth International Seed Testing Congress. Some particulars of this Congress, which was held at Cambridge from 7th to 12th July, have already appeared in the *Journal.** A full report of the proceedings, which will include copies of all the papers submitted and of the discussions which followed, will be placed on sale at an early date by His Majesty's Stationery Office.

The Use of "Tailings" or "Cleanings" from Grass and Clover Seeds.—During the season the Ministry made an inquiry as to the extent to which "tailings" or "cleanings" from grass and clover seeds are used for sowing in England and Wales. The result indicates that such a practice does not prevail to any appreciable extent. In certain districts in Wales where red clover is grown, such as the Vale of Glamorgan, the borders of Monmouth, Hereford and Montgomery, and the Valley of Clwyd, a considerable amount of "cleanings" of local grown red clover seed is reported as being sold among the farmers themselves, and a limited number of retail seed firms in these districts are also said to indulge in the practice, but reports from other districts show that except for small lots sold occasionally for sowing on such places as railway embankments, the bulk of the "cleanings" obtained by seed firms in England and Wales is sold for crushing or for export. There are, of course, many seed firms who clean locally grown seed to oblige their customers, in which case it is usual for the farmer to take the "cleanings" and "tailings" to "throw on the land." Although the sowing of "tailings" cannot, therefore, be

* See this *Journal*, August, 1924, pp. 403-5, and October, 1924, pp. 688-90.

described as widespread, it is practised to a certain extent, and it is desirable that those who adopt such a bad piece of husbandry should have brought to their notice the risk they run of contaminating their ground with a heavy crop of weeds. It is quite natural that a farmer who has a quantity of "tailings" on hand, which contains a small proportion of reasonably good seed, should feel that he cannot waste this material, particularly if he has a piece of poor waste land on which it can be sown. He should, however, bear in mind that the trouble which will follow as a result of sowing the weed seeds contained in the "tailings" will probably be many times greater than the benefit derived from the good seed. It must also be remembered that under the Seeds Act, 1920, it is necessary, in the case of a sale for an agricultural purpose, of a mixture containing any of the kinds of grass or clover seed scheduled thereunder, for the seller to declare particulars as to the germination, purity, etc., of each kind of seed contained in the mixture.

Prosecutions.—The following are brief particulars of the cases in which the Ministry has instituted legal proceedings under the Act during the past season:—

1. A firm having businesses in several parts of Kent was found guilty on 20th May of three offences connected with the sale of seed potatoes without the requisite written statement. It appeared that the practice of the firm was to issue a printed catalogue, but they apparently omitted to make any statement connecting potatoes purchased with any particular lot mentioned in the catalogue. A fine of £1 was imposed in respect of each offence.

2. At Gloucester, on 21st May, a firm of seedsmen was prosecuted for selling seed potatoes without giving the purchaser the written statement required by the Act. This case was only brought after verbal warning had been given to the defendant, without effect, some two or three weeks previously. In convicting and inflicting a fine of £3, the Bench expressed the hope that the case would serve as a warning.

3. On 23rd June a retail shopkeeper of Builth Wells was charged with making a false statement regarding seed potatoes, and also with failure to display the particulars required by the Act. Both of these charges were dismissed.

4. On the same day and before the same Bench, another retailer was prosecuted for making a false statement in respect of packets of onion seed. This case was dismissed on payment of 5s. costs.

5. On 8th July a firm of seed and corn merchants was charged at Birmingham with three offences relating to the sale of seed potatoes. The case was a peculiar one, in that, after the Inspector had verbally warned the firm, the seed potatoes in question were removed from the premises and exposed for sale at another shop belonging to the defendants, still without the written

particulars required by the Act. The Magistrates took the view, however, that the offences were not deliberate, and made an order for payment of two guineas special costs, intimating that future cases would not be dealt with so leniently.

6. Another Birmingham firm, of the multiple shop variety, was charged at Birmingham on 22nd July with failure to give the particulars required by the Act in the case of a sale of seed potatoes. A fine of 40s. was inflicted, together with costs.

7. At Birmingham, on 29th July, a shopkeeper was charged with making false statements in respect of packets of parsnip and onion seed, and fined 40s.

8. A charge of failing to furnish an Inspector taking samples with particulars of the analysis upon which red clover seed and red clover cleanings were sold was brought against a firm of seedsmen at Welshpool on 5th August, 1924. It appeared that, although a hundredweight of the red clover seed had been sold at the time when the sample was taken, the firm were not in possession of the required particulars. The Magistrates convicted and imposed a fine of £1.

Amendments of Seeds Regulations.—No amendments have been made in the "Seeds Regulations, 1922," so that, unless some unforeseen circumstances should arise, the Regulations will be the same during the 1924-25 season as those which were in operation last season.

Note.—Copies of the Seeds Act, 1920, and of the Seeds Regulations, 1922, may be obtained through any bookseller, or direct from His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2, price 3d. each.

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ENSILAGE.

II.—SUITABLE CROPS.

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ALMOST all kinds of herbaceous crops are capable of being made into good silage with the exception of the *Brassicæ*, plants of the cabbage tribe, which are too succulent, give rise to obnoxious smelling silage and are generally unsuitable. Although many crops can be converted into silage, it does not follow that all are equally suitable.

An ideal crop for ensilage should satisfy the following conditions:—(1) It should be easy and cheap to grow so that its cultivation does not interfere with that of other more important crops, and if seeding and harvest occur when other crops do not

require attention so much the better; (2) it should be a reliable crop, not subject to great variations in yield, so that the farmer can calculate with reasonable certainty upon his supply of winter fodder (the curse of the root crop in some districts is its uncertain yield); (3) it should be easy to harvest, capable of being cut with the grass-mower, easily carted and quickly chaffed for filling the silo; (4) it should be easily capable of reaching the required degree of maturity for ensiling, since immature silage is liable to be sour; (5) the silage produced should have a relatively high food value, should be digestible and contain a reasonable amount of albuminoids; and (6) lastly, it should provide either time for weed destruction before sowing or after harvesting, or for suppression of weeds by smothering.

No one crop in practice is likely to satisfy all these conditions perfectly, but these are the objects to be kept in mind in selecting the crop or crop mixture for silage.

The Tare or Vetch Crop and Its Mixtures.—The crop most commonly grown and most suitable for silage in Britain is some mixture of plants with vetches or tares. The tare plant is easily grown, requires little preparation of seed bed, produces a bulky crop of digestible, nutritious food, containing a high proportion of albuminoids, does not vary greatly from year to year in yield especially when autumn planted, and matures for silage generally between the hay harvest and the corn harvest. It possesses, however, when grown by itself one serious defect—its stems are so weak that they are incapable of holding the plant erect to a height of more than 12 in. to 15 in.; consequently the tare crop becomes laid and in damp weather becomes rotten and mouldy at the base, while it is also impossible to cut it without leaving a large proportion on the stubble. For this reason tares for silage are always grown in mixture with one or more other plants, which support the tares as well as provide forage.

The standing or holding power of any supporting crop grown in mixture with tares depends upon two factors. First, and most important, it depends upon the time of year at which it begins to shoot the growing point of its stem upwards in relation to the time when the tare does the same: if the tare shoots first or at the same time as the supporting crop then its tendrils cling to and bear down the shoots of the supporting crop and suppress them. It is most important, therefore, that a supporting crop be chosen which can be relied upon to shoot before the tare. Secondly, the supporting crop should have a strong straw so as to be able to carry the weight of the tare crop. The

plants most commonly considered for planting with autumn tares are the cereals, wheat, barley, oats and rye, and the bean plant. Of these, wheat generally fails because, though it has a stiff straw, it keeps tillering late in spring and does not start to send up its erect shoots till too late, so that these are caught by the tendrils of the tare and borne down by them. Barley fails because its straw is too weak. Rye is excellent for supporting the crop because it sends up its erect shoots early and its straw is fairly stiff, but, unfortunately, it matures too quickly so that its straw becomes fibrous and indigestible before the tares are fit to cut. It is, therefore, not suitable for silage except upon the thinnest sands where other cereals make poor growth, and here the crop should be cut at an early stage. The oat plant is undoubtedly the most suitable supporting crop for tares throughout England; it generally shoots just before the tare, supports the crop and comes to maturity at the same time as the tare.

The bean crop, on suitable land and if properly managed, is another good supporting crop to the tare; in dry districts it is of course useless on light land, but grows well on heavy land. Winter beans, if planted at the same time as tares, frequently fail to shoot before the tares and suffer the same fate as wheat; one method that has given satisfactory results consists in ploughing the beans in with a shallow furrow and drilling the tares and oats a fortnight or three weeks later; this procedure has the added advantage that the beans are covered more deeply and so protected from the ravages of rooks, partridges, etc., which otherwise prey upon them far into the winter. In addition to these qualities the bean plant in mixture makes very good silage.

During the last few years several series of plots have been laid down and cropped with different mixtures of tares and other crops to test their suitability for silage, on the University Farm at Cambridge. These have been weighed when fit for silage, and since the weight of green crop does not express the true yield accurately owing to variations in moisture content, samples from each plot have been taken and dried, and the weight of dry crop has been calculated. This gives a true measure of the yield of dry food and a much more accurate basis of comparison. Table I gives the results of one such experiment in 1923, and is typical of those obtained in other years.

This series was planted in the first week of October, 1922, upon poor light gravel soil in a fertile condition, having been dunged at the rate of 10 loads per acre before planting. The growing

Table I. SILAGE PLOTS, 1923.

Plot No.	Rate of Seeding.	Yield of Green Crop. Tons per Acre.	Percentage Dry wgt.	Yield dry Crop. Tons per Acre.	Standing properties of Crop.
1.	2 Bus. Tares 1 Bus. Grey Winter Oats	15.6	22.3	3.47	Very bad
2.	1½ Bus. Tares 1½ Bus. Grey Winter Oats	14.7	22.6	3.32	Bad
3.	1 Bus. Tares. 2 Bus. Grey Winter Oats	13.0	22.5	2.92	Fair
4.	1½ Bus. Tares 1½ Bus. Bountiful Oats	15.0	24.3	3.64	Fair
5.	1½ Bus. Tares ¾ Bus. Grey Winter Oats ¾ Bus. Rye	10.8	29.9	3.22	Good

season was favourable and the crops were good, but the figures expressing the weight per acre require to be discounted before using as a measure of the yield which a farmer would obtain, because in practice the plots, and especially the laid plots, could not have been cut so close to the ground, nor so regularly with a grass-mower as was done with the scythe. The figures, therefore, require to be used with discretion. One important point to notice is that although all plots were cut the same day and under similar conditions the percentage of dry weight varies from only 22.3 per cent. in plot 1 to 29.9 per cent. in plot 5, and indicates the importance of expressing the measured yields of silage crops in terms of dry weight per acre.

If we compare plots 1, 2 and 3, all of which were composed of mixtures of tares with grey winter oats in varying proportions of tares and oats. it will be seen that plot 1, with two bushels of tares to one bushel of oats, gave a heavier green crop than either plots 2 or 3 with more oats and less tares, and that the dry crops are also in favour of the heavier seeding of tares, though not quite so pronouncedly. The last column, however, shows that plots 1 and 2 were badly laid and could not have been cut successfully with the grass-mower; probably had this been used 25 to 50 per cent. of the crop would have been left on the stubble. This fact is most important in practice, since beginners in silage making frequently make use of a mixture containing a large proportion of tares, which is generally most useful when the mixture is grown for soiling cows or sheep-folding.

The next point brought out in the table is that black Bountiful oats support the tare crop better and result in a heavier yield than do grey winters; and if the crops had been measured as cut by a grass-mower this advantage in yield would have been

still further emphasised. On the other hand there can be no doubt that the softer, weaker straw of the grey winter oat produces fodder which is more digestible.

Plot No. 5 with rye, though it stood well and produced a heavy weight of dry crop, is not to be recommended because the rye becomes coarse and indigestible before the tares are fit to cut.

In practice it will be found that different mixtures should be used in accordance with soil and climate. In the dry eastern counties the following mixtures will give good results:—

On poor light land 1½ bus. of tares with 1½ bus. of grey winter oats give both a good yield and good quality material. *On better land* 1¼ bus. of tares with 1¾ bus. of Bountiful oats give a more satisfactory yield than the previous seeding, because this mixture stands better. *On heavy clay* 1 bus. of beans ploughed in with a shallow furrow followed by 1½ bus. of tares and 1½ bus. of Bountiful oats drilled three weeks later will give good crops.

Another mixture with tares which is both economical and gives satisfactory results is one composed of 1¼ to 1½ bus. of tares with 5 to 10 lb. of Italian ryegrass. On light, easy-working soils in the south this can be cut into the land with a disc drill soon after a corn crop is harvested, provided the land is clean, and gives good crops which are well supported above the ground by the stiff stems of the ryegrass. This mixture is cheap both for seed and for tillage, but is not advisable if the land contains much in the way of perennial weeds.

In districts where the rainfall is greater during late spring and early summer, spring-planted tares or peas in mixture with a leafy oat (*e.g.*, Clemrotheray) produce excellent crops suitable for silage. A mixture recommended by J. C. Brown* is 1 bus. beans, ½ bus. tares, ½ bus. maple peas and 2 bus. Clemrotheray or Duns oats. In still moister and cooler districts beans have been used in larger proportion with good results in a spring-planted mixture; in parts of Scotland and Ireland mixtures containing 3 bus. spring beans, with ½ bus. tares, ½ bus. grey peas and 2 bus. oats have produced good silage crops.

The Maize Crop.—The crop which has proved of the greatest value for silage, when regarded from the world point of view, is undoubtedly maize, and where climate and soil are suitable it produces a splendid silage crop: heavy, very nutritious, easy to cut and handle, and producing excellent silage. Unfortunately, maize is very sensitive to frost both in the seedling stage and

* This *Journal*, p. 725, November, 1920.

when maturing, so that in this country the growing period is short. None the less, in countries where somewhat similar conditions prevail, varieties have been bred and selected for habits of quick maturity which are being successfully grown for silage.

In England isolated farmers in warm localities and on early soils have regularly made good silage, but others on later soils have succeeeded only in producing very sour silage, which has been most unsatisfactory. This misfortune has been due largely to the fact that our seedsmen have selected, or our farmers have demanded, a variety named White Horse Tooth, which is most unsuitable for the purpose. It is a very tall showy variety which takes the eye because of its size, but it is slow to start and very slow and late to mature, so that it rarely if ever becomes really ripe enough for silage, and for similar reasons is far from satisfactory for green soiling—a purpose for which it is largely employed in the South of England.

During the last five years some 12 varieties of maize, commonly grown for silage in Canada and elsewhere, have been tried at Cambridge, and duplicated during the last two years by Mr. Frank Rayns of the Midland Agricultural College, Sutton Bonnington. These varieties, in comparison with White Horse Tooth, have given consistently good results. All of them have matured more quickly and have produced maize which, when cut, contained a much higher percentage of dry matter than the Horse Tooth. (See Table II.) The latter fact is a very important consideration when maize is to be ensiled, for excess moisture in the silo results in loss by drainage of the enpressed juice and the production of sour silage.

Table II. MAIZE VARIETY TRIALS, 1924.

	Cambridge.						Sutton Bonnington.		
Variety.	*Order of Maturity.*	*Green wt. per Acre.* Tons	Cwt.	*Percentage Dry wt.*	*Dry wt. per Acre.* Tons	Cwt.	*Order of Maturity.*	*Green wt. per Acre.* Tons	Cwt.
Saltzer's North Dakota ...	1	12	15 ...	17.60 ...	2	5	2 ...	19	3
Longfellow ...	2	13	19 ...	16.53 ...	2	7	1 ...	16	8
Giant Prolific Sweet Ensilage	2	14	17 ...	17.13 ...	2	10	2 ...	19	3
White Cap ...	4	12	18 ...	17.50 ...	2	6	4 ...	16	1
Golden Glow ...	5	13	5 ...	16.85 ...	2	5	5 ...	15	11
Wisconsin No. 7	6	15	0 ...	16.13 ...	2	8	5 ...	18	14
Leaming Yellow	7	13	16 ...	16 35 ...	2	5	7 ...	20	7
Red Cob Ensilage	8	15	15 ...	13.88 ...	2	3	8 ...	14	16
White Horse Tooth ...	9	17	9 ...	13.20 ...	2	7	9 ...	25	11

Table II gives the results of the maize variety trials in 1924, which are typical of those of previous years. At Cambridge the maize was grown upon a poor, thin, gravel soil receiving 12 loads of dung per acre, and the figures represent the mean of four series of plots. The seed was planted on 27th and 29th May, the seedlings being thinned to one foot apart when one foot high, and the crop harvested on 2nd and 7th October. At the Midland College the maize was grown upon a better and sandy loam soil, and manured with 8 tons of dung together with 2 cwt. of superphosphate, 2 cwt. of steamed bone flour, 1½ cwt. of muriate of potash, and 1½ cwt. of sulphate of ammonia (the same manure as that used for potatoes on the rest of the field). The crop was planted on 24th May and harvested on 29th September. The varieties in the table have been arranged in the order of maturity at Cambridge, and it will be noticed that White Horse Tooth, the variety now commonly grown in England, is at the very bottom of the list. It germinated more slowly than any other variety, developed no male inflorescences till the end of September, and formed no female inflorescences or cobs of maize.

The three varieties at the top of the table, Saltzer's North Dakota, Longfellow and Giant Prolific Sweet Ensilage, were each several weeks in advance of White Horse Tooth in maturity, coming into flower during the first half of August and being well set with well-developed cobs just in the milk stage on 7th October, when they were cut. Saltzer's North Dakota and Longfellow have each year shown similar early maturity but in previous years Giant Prolific Sweet Ensilage has been at the middle of the table for maturity. It is possible that the strain of seed obtained in 1924 was different from that of earlier years. The variety White Cap was easily fourth in order of maturity and in previous years has been close up to the earliest varieties and in advance of the remaining varieties on the list, which, though distinctly earlier than White Horse Tooth, do not compare with the first group of three.

In the column expressing the green weight per acre the weights of crop are, roughly, inversely proportional to the order of maturity, but, as the next column shows, the early maturing varieties have a considerably higher percentage of dry matter. The weight of green crop is therefore no reliable guide to the food value of the crop. The column showing the dry weight of crop per acre is the important column. An examination of this shows a remarkably uniform yield for each variety—the variation being only from 2 tons 3 cwt. in the case of Red Cob

Ensilage to 2 tons 10 cwt. for Giant Prolific Sweet Ensilage. This is important, for it means that in the short English summer the early maturing varieties not only mature more quickly, and contain less moisture, but produce just as great a weight of dry food as the taller late varieties.

Turning now to the last two columns in the table, relating to the results obtained at the Midland College, it will be noticed that the order of maturity is almost precisely the same as that obtained at Cambridge—a result which is most satisfactory. The first three varieties in each case are the same, though Longfellow is here placed before Saltzer's North Dakota, but the maturing of these at both places was so close that the exact order is of little moment. Again White Horse Tooth was easily last as regards maturity. The weight of green crop per acre is larger in all cases except Red Cob Ensilage than at Cambridge, partly perhaps owing to the soil, but the order agrees fairly well with that of the green weights at Cambridge, and shows White Horse Tooth to have produced the remarkable crop of 25½ tons per acre, a weight, however, which would probably be found misleading if it were capable of conversion into dry food. Unfortunately it was found impossible in this case to determine the percentage of water in the crop. In view of experience not only in 1924 but in previous years, it is, however, probable that the green crops of 19 tons 3 cwt. yielded by Saltzer's North Dakota and Giant Prolific Sweet Ensilage represent greater food value than the 25½ tons of Horse Tooth, while they would certainly be more suitable for silage owing to earlier maturity.

The conclusion to be drawn from these results is that Saltzer's North Dakota, Longfellow, and perhaps Giant Prolific Sweet Ensilage, if the same strain can be obtained, are superior to White Horse Tooth for ensilage in this country and probably will also be found of better value for green-soiling. It would be worth the while of county organisers in the southern counties to arrange trials of these early varieties against Horse Tooth, and of seedsmen importing maize to introduce these varieties to their customers.

Sunflowers.—At Cambridge, in 1924, sunflowers yielded a green weight of 12 tons 16 cwt., with a dry weight of 2 tons 7 cwt., or 18.35 per cent. of the green crop. This indicates (*cf.* Table II) that this crop is capable of producing as heavy a yield of dry material as maize. Further, the seed is cheaper, the crop is easier to grow, it matures more quickly and is extraordinarily good as a smothering crop, no weed being able to

tolerate its shade. In some parts of America where the climate is unsuitable for maize this crop has been grown on a considerable scale for silage. The silage made from sunflowers, however, is not very palatable, and if left too long before cutting becomes very fibrous and woody. It is not a crop to be widely recommended where other silage crops can be grown.

Rotation Grasses and Clovers.—All kinds of grass and leguminous fodder crops are capable of being made into good silage, but generally a mixture of grass and clover makes better silage than a pure clover, which frequently possesses a strong smell. When such crops are grown for silage, it is usual to convert the first crop into hay, when the weather is generally good, and the second and third crops into silage towards the end of the summer; or if bad weather prevails when the first crop is fit to cut, this, too, may be made into silage. In choosing the actual mixture to be sown one should be guided by the species which best suit the climate and soil in question, giving special attention to those which produce a bulky growth. One mixture which has been successfully used for silage upon suitable soils in southern England is lucerne with Italian ryegrass or cocksfoot, at the rate of 12-15 lb. of lucerne with 5-10 lb. of ryegrass or cocksfoot. Such a mixture may be sown amongst a corn crop and, if well established and suitably manured, will hold the ground for three or more years, and give one cut for hay and two for silage each year.

Meadow Grass.—Meadow grass grown in marshy wet land, which produces very coarse hay or may be difficult to "make," can with advantage be made into silage; and also any crops of grass intended for hay in rainy districts or rainy seasons when the chances of making good hay are remote. All such crops, properly managed, can be made into perfectly good silage with certainty either in a tower silo or in pit or stack.

* * * * * *

FERTILITY IN SHEEP.

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AN endeavour to collect data relating to fertility in sheep for the season 1923-24 was made by circulating a questionnaire to members of various breed societies. The number of completed returns was comparatively small, so that the data collected may not represent the conditions as accurately as would be desirable,

but they are sufficient to warrant the general conclusions which have been drawn and serve to supplement the data which have previously been collected from various sources.

It is characteristic of certain breeds of sheep that they are more fertile than others, but there are many influences which contribute to the ultimate expression of the character. The work of Hammond (1) shows that the limiting factor is the number of eggs shed at each oestrous period; Marshall (5) states that there is little doubt that barrenness is due normally to the absence or great scarcity of graafian follicles available for ovulation during tupping time. The latter writer and Heape (2) (3) early called attention to a number of special causes which influenced fertility, the most important probably being such nutritional causes as influence the condition of the ewes at tupping time and during gestation. Other influences include the age of the ewes, the district in which the flock is kept, climatic conditions during gestation, the methods of sheep husbandry employed, the period at which mating occurs, and the proportion of ewes to rams during service. The question of fœtal atrophy and lethal factors leading to abortion cannot be ignored.

The data presented will supply further information on the effects of some of these influences.

Data Presented.—In Table I are given the yields of lambs from ewes of the various breeds of which data have been obtained, together with the number of flocks from which the sum totals are taken. In each case the flocks are pure-bred, the ewes being mated to rams of their own breed. The number of flocks is given as an indication of the measure of the care to which each flock has been subject, since it is a safe generalisation that the smaller the flock the better are the individuals in the flock cared for;

Table I. **Lambing Percentage.**

Breed	No. of Flocks	No. of Ewes	No. of Lambs	Lambs per 100 Ewes.
Border Leicester ...	32	651	1,347	207.0
Leicester	8	434	660	152.1
Dorset Horn	9	2,096	3,063	150.9
Suffolk	9	1,003	1,491	148.7
Oxford Down	34	3,465	4,797	138.4
Lincoln	10	1,375	1,761	128.1
Southdown	4	961	1,216	127.3
Hampshire Down ...	8	2,328	2,833	121.7
Blackface	10	5,768	5,292	91.75
Other pure breeds ...	9	1,292	1,682	130.2
	133	19,373	24,142	124.6

(1) These figures refer to the bibliography at the end of this article.

thus the high fertility found for the Border Leicesters is probably due to a great extent to the small size of the flocks from which the data were obtained. It must be pointed out that the figures given in Table I are not actually the numbers of lambs *born*, though in the majority of cases this is so; the other cases comprise those in which the number of lambs alive at weaning or at castrating time was given. This does not prevent the data tabulated from being of statistical significance. Under the head " other pure breeds " are included Kent or Romney Marsh, Cheviot and Shropshire.

Table II gives summarised data on the frequency of multiple births in sheep; a comparison of Tables I and II is instructive. As has been frequently demonstrated by various authors, fertility is very closely related to the percentage of twinning, or of total multiple births; this is an obvious conclusion, but the proportion of multiple births can never be a measure of fertility because the questions of barrenness and abortion are involved.

Table II. **Multiple Births.**

Breed	No. of Flocks	No. of Ewes	Ewes with Twins	Percentage Twinning	Ewes with Triplets	Percentage Triplets
Border Leicester ...	31	599	446	74.5	53	8.95
Leicester	7	354	186	52.5	7	1.98
Suffolk	8	887	454	51.2	22	2.5
Dorset Horn	9	2,096	909	43.4	66*	3.1
Oxford Down	30	2,842	1,202	42.3	83†	2.6
Lincoln	9	1,293	491	38.0	37	2.9
Southdown	4	961	288	29.97	4	0.4
Hampshire Down ...	7	2,007	517	25.8	11‡	0.5
Blackface	6	4,048	123	3.0	1	0.025
Others	9	1,292	425	32.9	17	1.3
	120	16,379	5,041	30.8	301	1.8

The figures given under " Number of Flocks " and " Number of Ewes " differ from those in Table I because they are taken from returns in which were given the actual number of lambs born.

The percentages of barren ewes and ewes which aborted are given in Table III; it was found that the figures for abortion were reliable in only very few of the returns, and in other cases it was impossible to differentiate between ewes which were actually barren and ewes which had aborted relatively early in pregnancy, the latter class being included in the number given under

* Also 1 ewe with quadruplets.

† 83 ewes with triplets out of 3,171; also 2 cases of quadruplets out of 3,465.

‡ 11 ewes with triplets out of 2,328.

"barren." It is interesting to note that a case is recorded of a ewe aborting early in pregnancy and being served again by the ram the following day.

Table III. **Barrenness.**

Breeds	Ewes	Barren Ewes	Percentage Barren	Aborted	Percentage Abortion
Blackface	4,224	247	5.9	38*	1.1
Lincoln	781	41	5.2	—	—
Border Leicester	629	22	3.5	(8)	—
Southdown...	961	28	2.9	—	—
Oxford Down	3,253	83	2.6	55	1.7
Suffolk	1,003	26	2.6	(7)	—
Dorset Horn	2,096	47	2.2	18	0.9
Hampshire Down	2,328	31	1.3	65†	2.8
Leicester	301	3	1.0	—	—
Others	1,078	31	2.9	(8)	—
	16,654	559	3.4	—	—

A number of returns gave accounts of the behaviour of certain breeds in crosses: no endeavour was made to collect data under this head, but those obtained were merely incidental and have been summarised in Table IV.

Table IV. **Crosses.**

Breeds	Ewes	Ram Lambs	Lambs undistinguished	Ewe Lambs	Singles	Twins	Triplets	Barren	Aborted
Suffolk x Leicester ...	180	—	248	—	—	—	—	—	—
B. Leicester x Suffolk ...	5	6	—	3	2	2	1	—	—
B. Leicester x Blackface ...	162	—	170	—	—	—	—	—	—
B. Leicester x Blackface ...	80	32	—	48	—	17	—	3	2
B. Leicester x Cheviot ...	314	60	234	70	232	66	—	12	(8)
Oxford x Hampshire ...	77	—	85	—	61	12	—	3	1
Ryeland x Hampshire ...	50	34	—	41	24	24	1	1	—
Southdown x Kent ...	80	59	—	53	44	34	—	2	—
Various‡ ...	450	53	659	55	—	—	—	—	—
Totals ...	1,398	244	1,396	270	363	155	2	21	—

Summary:—**1,398 ewes** yield 244 + 1,396 + 170 = **1,910 lambs** — **136.6 per cent.**
155 ewes with twins out of 606 — **25.6 per cent.**
Barren: 21 out of 606 — **3.5 per cent.**
Sex Ratio: Ram : ewe = 244 : 270 or **90.4 : 100.**

* Out of 3,449 ewes.

† Of these 65, 37 are recorded from 1 flock and are accredited to chasing by dogs a few days previous.

‡ Includes B. Leicester x Half Bred; Suffolk x Half Bred; Oxford x Half Bred and B. Leicester-Suffolk x Half Bred.

Marshall (5) (6) (7) (8) and others have dealt with the subject of "flushing," but few comparative data have hitherto been collected in spite of the fact that many flockmasters flush their ewes with the object of increasing their crop of lambs. In this investigation it was possible to collect information on this practice and this is given in Table V, which also includes figures showing the sex ratios obtained in flushed flocks of the different breeds. In one particular case it was possible to collect data which extended over a considerable number of years, and these are briefly summarised in Table VI.

Table V. **Flushing.**

Breed	Ewes	Lambs	Lambing percentage	Sex Ratio in Lambs
Oxford Down	370	554	149.7	116.9 : 100
Dorset Horn	457	635	138.9	79.4 : 100
Lincoln	174	264	151.7	98.3 : 100
Suffolk	338	541	160.1	104.2 : 100
Southdown	196	271	138.3	112.6 : 100
Border Leicester ...	180	302	167.8	91.3 : 100
Leicester	40	56	140.0	86.7 : 100
Total ...	1,755	2,623	149.5	98.2 : 100

Table VI. **Flushing.**

Mean size of flock during 8 years	391.625
Lambing percentage over 7 years flushed	129.9
" " when flock largest	125.95
" " " " smallest	131.3
" " " not flushed	116.2

The sex ratio in sheep has been the subject of investigation by various workers; the additional information now obtained is given in Table VII. The numbers of lambs recorded are small compared with Table I, because many breeders filled up the forms before the time when the lambs were sorted for castration or drafted for sale.

Table VII. **Sex Ratio.**

Breed	Ram Lambs	Ewe Lambs	Males per 100 Females
Blackface	1,387	1,468	94.5
Oxford Down	2,136	2,212	96.6
Hampshire Down ...	467	516	90.5
Dorset Horn	961	1,065	90.2
Lincoln	413	410	100.7
Suffolk	753	754	100.0
Southdown	622	573	108.6
Border Leicester ...	655	670	97.8
Leicester	272	269	101.1
Others	822	776	105.9
Total ...	8,488	8,713	97.4

Lambing Percentages.—Returns of 133 flocks for the lambing season 1923-24 are available, and from a consideration of

Tables I, II and III conclusions fairly representative of certain pure breeds in Great Britain and Ireland may be drawn. The records are, however, insufficient to warrant classification according to district, altitude and type of land, all of which undoubtedly influence fertility to a considerable extent.

Heape (2) found that the Wensleydale breed was the most fertile of the pure breeds of which he had records, the yield being 177.43 per cent. from 319 ewes, but of the breeds which he tabulated separately the Suffolk was found to rank highest, with a fertility of 141.77 per cent. The results given in this paper do not correspond entirely with his, but one is forced to similar conclusions with regard to the factors influencing fertility in sheep. High fertility depends on a high percentage of multiple births associated with low percentages of barrenness and abortion, and it is the factors that act on these that are responsible for the differences in fertility after the primary hereditary factors have been considered. That heredity does play some part in fertility is undoubtedly true; the mere fact that there exist considerable differences between flocks of different breeds kept under similar conditions points to this conclusion, and work on pigs and smaller laboratory animals provides evidence in support, while investigations on sterility, the converse of fertility, have shown in many cases that hereditary factors are involved.

Flushing.—From the Tables it will be seen that there is some correlation between barrenness and low percentage of twins, hence it can be concluded—as has been pointed out by Marshall (8)—that in sheep barrenness may commonly be due to similar causes and conditions as those producing a scarcity of twins, and nutrition is probably one of the most important of these. Table V shows that flocks where the ewes were flushed before and during tupping time, that is, where the ewes were brought to a high degree of nutritional activity without being in too high a "condition," yield a higher percentage of lambs; the figures 149.5 per cent. flushed and 124.6 per cent. not flushed indicate the importance of this practice of utilising the nutritional factor. In the case of the flock where records were available over a period of 8 years, during one of which the flock was not flushed, these amply support the conclusion that flushing is beneficial to the subsequent lamb crop from the point of view of numbers. Many breeders state that the practice should not be employed for one season only, but should be continued in consecutive seasons to obtain the most satisfactory results, as if it is

suddenly discontinued the yield tends to fall below the average. In the flock whose records are incorporated in Table VI, in the year succeeding the non-flushed season the yield was about 2 per cent. below the average for the breed.

It was found that by far the greater number of multiple births occurred in the early part of the lambing season at a period corresponding to that at which the ewes were going fastest to the rams; this time of most active service varied somewhat according to the treatment the ewes and rams had undergone before mating, but if the ewes were in improving condition and the rams fit for service, it occurred usually during the beginning or early middle period of the tupping time. Two cases in which accurate figures are given are worthy of notice; in one flock, which had been flushed, at a time corresponding to that at which the ewes had been on the best keep the proportion of singles to twins in 30 hours was 3:19. In a second flock the proportions of single to multiple births was as follows: 1st fortnight 1:2.1, second fortnight 1:2.6, third period 1:4.5, but this would seem exceptional.

Barrenness and Abortion.—Barrenness and abortion (apart from cases of abortion due to pathological causes) depend largely upon the management and food supply of the flock, management including proper treatment of ewes and rams with respect to removal of obstacles to easy access, such as clipping wool from the parts surrounding the genital organs, and arranging that the number of ewes per ram does not exceed his capabilities (this can only be decided by individual experience and depends largely on the breed and age of the ram). Management during pregnancy has much to do with abortion—the ewes should be kept in a steady condition for the early stages, little disturbed, and on well-drained land which is not "sheep-sour"; all predisposing causes to a state of debility should be carefully avoided if possible. In practically all cases where breeders gave their experiences with sheep in show condition it was considered to be detrimental, the ewes being usually too fat at tupping time and the rams lazy and ineffective, leading to a higher percentage of barrenness, while if the ewes did become pregnant the lambs were frequently small and weak. High show condition is less dangerous in young sheep, as they are more readily reduced to a fit condition for breeding.

Hammond (1) found that the majority of atrophic fœtuses in sheep occurred at an early stage of development, and he suggested that in-breeding, fatness and genetic differences were

possible causes of fœtal atrophy, through their effects on the nutrition of the ovary. Hence, we have a suggestion of reasons for differences in fertility in various strains or breeds. Lethal factors, leading to abortion, are known to exist in many animals, including sheep; barrenness may be due to similar factors, causing fœtal atrophy in early stages. Heape (2) showed that Wensleydale and Suffolk ewes tended to produce fewer lambs when mated to rams of other breeds than when mated to rams of their own breed, while Dorset Horn ewes were usually more prolific with rams of Down breeds than when mated to Dorset Horn rams and required "to be covered by rams of another breed, in order that they may be stimulated to the greatest generative activity." In Tables I and IV some indications are found that a similar state may obtain in Hampshire Downs and Blackfaces. Also these breeds—Dorset Horn, Hampshire Down and Blackface—appear to show the lowest sex ratios, a point which may be of significance, as in many known cases of lethal factors it is the male sex which is most affected. It is possible that the tendency to higher fertility in certain crosses is due to the dominant partners of lethal factors being brought in, with a resulting increase in fertility.

The age of the ewes also has an important bearing on fertility and barrenness; records obtained of shearling ewes were insufficient to present any definite comparative data, but indicate that the yield from shearlings is lower than that from older ewes, the best breeding age being (throughout all the breeds mentioned) 3-4 years. Data collected by Jones and Rouse (4) in America indicate that 5-year-old ewes give the highest yield, but undoubtedly younger ewes are more favoured in this country for breeding purposes. The results for shearling ewes for all breeds shown in the tables were:—lambing percentage 109.8, multiple births 14.9 per cent., barren 4.97 per cent. Shearling rams are found to be best on the whole, but ram lambs give very satisfactory results in the Down breeds and older rams (2-4 years) in the Blackface.

The Sex Ratio.—Studies of sex ratio have been made in many species of animals, and differences have been found between the ratios at conception (calculated), at birth, and at maturity. In most species there is, during pregnancy, a differential mortality favouring the female sex, so that at birth the (secondary) sex ratio usually shows a preponderance of females. Several investigations have been made on the sex ratio, in sheep, and the most common figure is that of about 97 males

per hundred females (Doncaster and others 97.7; Heape 97.4); the result obtained here (Table VII) agrees with this figure. It is the belief of many breeders that the practice of flushing has some pronounced effect on the sex ratio, and though it is indeed possible that some influence may be exerted by subsequent alterations in the nutritive supply to the fœtuses, and thus some variation in the conditions affecting the differential mortality *in utero*, the figures given in Table V (flushed), while showing some considerable variation, do not, for the total, differ markedly from those given in Table VII for the whole of the flocks considered.

Summary.—Data from 133 flocks, representing 19,373 ewes are presented.

Fertility is influenced by those factors, hereditary and otherwise, that affect primarily the tendency to produce a high proportion of multiple births and a low proportion of barrenness.

There is apparently a correlation between barrenness and low percentage of twins.

The practice of flushing is conducive to a high lambing percentage.

Multiple births occur at the time which corresponds to the time of greatest sexual activity in the flock.

Barrenness and abortion (apart from pathological causes) are largely due to environmental factors, but the importance of hereditary factors cannot be neglected; the age of the ewes is also important, and show condition has a prejudicial effect.

The sex ratio in sheep is about 97 males to 100 females.

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THE FIELD VOLE.

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SMALL animals are much more likely to be detrimental than large ones, partly because they multiply more rapidly and partly because they escape more readily. The Field Vole is a case in point. The length of the head and body of a mature male is only about four inches (the female a third of an inch less), and the tail does not exceed an inch and a half. So we have to deal with a very small animal, as compared with a rat for instance. But against the small size we have to weigh the multitudinous numbers, for there are three or four litters in the year with an average number of five young ones each time. Thus voles tend to become very abundant—and then the grass begins to suffer. Since that is their favourite food, there is much to be said for the commonest of the popular names for the little creatures, namely, "grass mice."

Many authorities distinguish the Highland Field Vole or Grass Mouse (*Microtus agrestis*) from the Common Field Vole or Grass Mouse (*Microtus hirtus*) which is the common species in England and the Scottish Lowlands. The former represents the older stock, but the two kinds are very nearly related and may be considered together. Once the splitting up of species begins, it is difficult to know where to stop.

General Appearance.—Field voles are usually either russet-brown or greyish-brown above and greyish-white below, but there is considerable variability in the colouring. In many cases it is well suited to hide the animals against the background of the soil, serving as a "cloak of invisibility."

When we look at a field vole we notice at once the blunt muzzles, the broad head, the inconspicuous ears almost buried in the fur (so different from the upstanding ears of a mouse), the short hairy tail. When we look more closely we notice the moderately hairy soles of the feet, the six or seven naked pads, a sharp nail on the minute thumb, the two strong chisel-edged front teeth (incisors), the three cheek teeth (molars) which continue growing throughout life as they get worn away on the surface. It is worth looking for a skull that the ants have cleaned, for then we can more readily examine the structure of the teeth with a lens, and observe, for instance, the neat little zig-zag triangles of enamel on the crown of the molars.

FIG. 1.—The Field Vole.

Habits.—Field voles are gregarious and companionable, but they show no co-operation or social life in the strict sense. They frequent pastures, arable land, bents, moors, plantations, hedgerows, and similar places, from Cornwall to Caithness, and in Europe generally. But they do not occur in Ireland. The food they like best is what they find in the succulent bases of grass stems, but they have a very wide range of appetite for shoots and roots, fallen corn and leaves, and bark, when the worst comes to the worst. The chisel-edged incisors are well suited for slicing and gnawing, and the back teeth for making pulp.

Field voles work by night as well as by day, and all the year round. If frost is very severe they may fall "asleep" for several days, but they should not be called hibernators. Sometimes they lay up stores for the winter, but this does not seem to be common or necessary in Britain. At all times the appetite of these rodents is enormous, and they require a good deal of water. They make runs on or just under the surface, and these often intersect in a complicated way so that a plan reminds one of the streets of a town. One and the same run may be above ground at one place and underground at another. The runs seem to be common property. At other times the field voles make deeper burrows to get at roots or to form a nursery in cold weather, but they are not in any special way suited for burrowing, as moles are, or for climbing, like harvest mice. They run smartly, without bounding, and they do not bite when they are caught. They are good swimmers. They probably sleep a good deal between meals, but they sleep lightly. They are careful in keeping their fur clean—as careful as cats; and they have also cleanly ways of disposing of their ordure. Their voice, used when they are excited or hungry, is "half a grumble, half a squeak."

Family Affairs.—It seems that the field voles live together in pairs, but there is some indication that there are many more males than females. We do not know enough to tell whether they are monogamous in actual fact. Breeding begins in April and may continue till winter, three or four litters being common.

The number of young is often between three and six, but there may be litters of ten when food is abundant and the weather genial. The female has eight teats. The period of gestation is believed to be about 24 days, and a suckling mother is often pregnant. All this points to the possibility of rapid multiplication, but it should be noted that the field vole is not nearly so

prolific as the mouse or the rat. Mr. Barrett-Hamilton notes in his fine "History of British Mammals" that in captivity the male may be safely left with his family, though he will devour strange litters. This points in the direction of genuine monogamy.

Vole Plagues.—From ancient times vole plagues have been known, and one may recall the defeat of Sennacherib's army owing to the innumerable voles that came by night and gnawed away all the quivers, arrows, and bowstrings. The last British plague on a big scale was in 1891-93, when large areas in the South of Scotland were turned into desert. Mild weather brings about an abundance of grassy food, and the voles have large litters. Beasts and birds of prey have their innings, and they also multiply more than usual; but they cannot stay the tide of rodent life. Gradually the grass gets scarcer and the field voles take to unusual ways of feeding, such as barking the trees and gnawing at their roots. Sooner or later, however, famine sets in among the voles; fertility drops; some disease occasionally gets a grip; the numbers sink to a minimum; the vegetation begins to show face again—the plague is over. But much damage to agriculture is often done before the balance is restored.

It is usual to refer "mouse years" to two causes—unusually mild and moist weather, on the one hand, and the destruction of natural enemies on the other. There is no doubt that both these causes will tend to favour the increase of voles, but one may ask whether there is not some obscure factor producing a natural cycle. Plagues have occurred in places where there was no game-preserving reduction of the beasts and birds of prey; and the facts do not seem to warrant more than a cautious statement to the effect that great reduction in the number of natural eliminators will tend to a great increase in the number of voles. Among the natural checks we may mention weasels, stoats, foxes, owls, kestrels, crows and rooks.

It cannot be said that man has been very successful in combating vole plagues. Vigorous use has been made of poisons, infection with a bacillus, burning out, hunting with dogs, flooding, trapping, and making pitfalls much broader at the bottom than at the mouth. Perhaps the safest poison to use is a preparation containing red squill or barium carbonate. It is probable that vole plagues on a small scale are not infrequent, and it is common sense to try to nip them in the bud. A serious vole plague is so costly that its beginnings should be carefully

scrutinised. Besides the judicious encouragement of the natural enemies already mentioned, there is the counteractive of destroying rough grasses about hedges and field margins and waste places *in the vicinity of pasture.* This tends to rob the field voles of part of their shelter and to expose them to hungry eyes. In a deep sense it may be said that the better the agriculture, the fewer voles there will be

What Harm do they do?—On three counts at least there is a strong case against field voles. First, they destroy the pasture by eating the bases of the grass stems. They sometimes do similar damage in corn fields and they are fond of clover leaves and the like. Second, their networks of tunnels underneath the surface of the ground may seriously disturb seed beds and young roots. Thus they do much damage in disturbing as well as in devouring. Their tough summer nests, made of dried grass, are sometimes troublesome to the reaping machines. Third, they often ring young trees, cutting off the bark just above the ground. They may also nibble through the roots. A common preventive is to surround the base of the tree with a cylinder of wire-netting of narrow mesh. pressing the lower edge of the cylinder well into the ground. A poison wash mixed with starch and glycerine may also be brushed on to the base of the tree.

Inter-Relations.—The circle of the field vole's life cuts many other circles, such as those of grasses, weasels, kestrels, and man. Charles Darwin was probably referring to field voles in his story of the "field mice" which destroy the combs and nests of bumble-bees and thus lessen the useful work of these insects in pollinating the red clover. Field mice also destroy a destructive sawfly that attacks the larch.

Bank Vole.—Much less important from the agricultural point of view is the Bank Vole (*Evotomys glareolus*), a rather smaller animal than the field vole, ruddier above and whiter below, with slightly longer ears and tail. Its cheek teeth are rooted in the adult, which is never the case in the field vole. It likes sheltered dry places and often finds its way into gardens, where it attacks bulbs and newly-sown beans and peas. It also does much harm in plantations. As it works chiefly at night it is seldom seen. It does not seem to multiply so quickly as the field vole, and that is something to be thankful for.

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FOURTH REPORT OF THE BASIC SLAG COMMITTEE.

THE Fourth Interim Report of the Ministry's Permanent Committee on Basic Slag, recently presented, reviews the work of the Committee in 1923.*

The original purpose of this Committee was to consider the possibilities of development and improvement of the manufacture of basic slag and the extension of its use. The value of slag to the maker is, however, so small in comparison with that of steel that he is unable to modify his processes for the purpose of improving the slag. The process is determined solely by the steel-maker's requirements, and the farmer must accept the slag offered him or find a substitute.

The Committee therefore turned to the second part of its terms of reference; the possibility of extending the use of basic slag. Obviously the best method of doing this is to ascertain by means of field experiments the conditions in which present-day slags act sufficiently well to justify the farmer in using them extensively. Some experiments on this subject are being made already by the Agricultural Education Association. The Committee found it necessary to make further experiments itself, which are being carried out at Rothamsted and near Cockle Park.

Use of Basic Slag in Agriculture.—The use of basic slag in agriculture showed a big decline in 1921, but since that date there has been a gradual improvement. Figures relating to production, disposal, imports and deliveries for the United Kingdom (including all Ireland) are brought together in the following table:—

PRODUCTION AND USE OF BASIC SLAG.

Year ending 30th Sept.	*Produced by Manufacturers*	*Ground for Fertiliser*	*Excess of Imports over Exports*	*Deliveries for Agricultural Purposes. England and Wales*	*Deliveries for Agricultural Purposes. United Kingdom*
	Tons	Tons	Tons	Tons	Tons
1920	701,393	508,240	—4,105	444,000	548,000
1921	377,181	252,948	33,819	248,000	261,000
1922	461,815	338,040	48,473	247,000	263,000
1923	699,541	301,798	79,032	278,000	291,000

* Copies of the Report can be obtained from the Secretary of the Committee: Mr. W. R. Black, Ministry of Agriculture, 10, Whitehall Place, S.W.1.

The composition of the Committee is as follows:—

Sir J. Russell (Chairman), Mr. T. Baxter, Mr. G. A. Bellwood, Mr. Colin Campbell, Dr. Arthur Cooper, Mr. W. J. Cutts, Mr. G. Hatton, Mr. M. Manneberg, Mr. G. V. Parker, Mr. H. G. Richardson, Dr. W. Somerville, Mr. J. G. Stewart, Mr. B. Talbot, Mr. E. Ullyott.

If the quantities ground for fertiliser are reckoned in units of tricalcic phosphate, the increase in 1922 is found to be maintained in 1923, the 301,798 tons for 1923 containing a larger proportion of higher grades than the 338,040 tons for 1922. The figures of deliveries for agricultural purposes do not give the total amounts used in agriculture; to obtain these quantities, such figures must be increased by the imports of ground slag; unfortunately, in the figures of imports ground slag is not distinguished from unground slag. As a rough approximation, however, it seems as if the annual consumption of slag in agriculture is 300,000 tons in England and Wales.

The use of basic slag in agriculture may be expected to depend to some extent on supplies of other phosphatic manures. The Committee has made an attempt to estimate the quantities of superphosphate and phosphate rock used in agriculture in this country. As with basic slag, the maximum consumption in the period 1920-1923 was in 1920 and the smallest in 1921, since when there has been a steady increase.

The Evaluation of Basic Slag.—In dealing with the results of the field experiments, the Committee was at once confronted with the difficulty that they did not show as close an agreement as is desirable with the expectations based on the conventional methods of chemical analysis. While the high soluble slags acted better than slags of low solubility, there was no apparent relationship between the actual figures for solubility and those for yield; thus a slag of 80 per cent. solubility was not necessarily better than one of 60 per cent., and a slag of 20 per cent. solubility might be more than one-quarter as effective as one of 80 per cent. Attempts were therefore made in the Chemical Department at Rothamsted to find a better chemical method of valuing slag, and after much preliminary investigation it was found that the percentage of fluorine in the slag gave a better indication of its value than did any of the other methods that suggested themselves. The determination of fluorine is a very difficult matter, but the Chemical Department has worked out a method, described in an appendix to the Committee's report, that is sufficiently accurate and can be carried out in any analytical laboratory. It is now being applied to a number of commercial slags. There is good reason to hope that this part of the Committee's work will lead to considerable improvements in the method of valuing basic slag.

Field Experiments with Phosphatic Manures.—The Committee's experiments consist of field trials both on arable and grass land (and in the latter case both meadow or hay land and grazing land) of the two distinct types of open hearth basic slag, made respectively with and without fluorspar, and of a North African mineral phosphate. These experiments, and those of the Agricultural Education Association, have not gone on sufficiently long to allow the deduction of definite conclusions, but certain indications are coming out which are set forth below:—

(i) It appears that grass land laid in for hay may reasonably be expected to give increased yields from dressings of slag if:—

(*a*) The soil is of the boulder clay or heavy marl type;

(*b*) The yield of hay is 20 cwt. or less per acre.

In these circumstances the development of wild white clover becomes possible, and once this occurs there results an improvement in the herbage. The yields can be pushed up to about 25 or 30 cwt. per acre. The improvement is, however, greater than that indicated by the mere measurement of yield, since it is also seen in the quality. As a rule the high soluble slags are quicker in action than those of low solubility, which in turn are more effective than the Gafsa phosphate of equal fineness of grinding. The experiment has not been tried, however, of comparing the low soluble slag with Gafsa ground to the fineness now used in Northumberland, viz., to pass the 120 mesh sieve.

On the other hand, slag may fail to produce improvement in the herbage:—

(*a*) If the soil is lighter in texture than boulder clay or heavy marl;

(*b*) On medium or heavy soils where the yield is already 25 cwt. or more of hay per acre.

Experiments are now being made to see whether the addition of kainit to the slag will cause an increased yield in these cases. From the fact that nitrogenous manures increase the yield it may be inferred that the soil and water conditions would allow of greater growth.

(ii) Owing to the cost of the experiment it is more difficult to collect precise information as to the effect of slag on grazing land, although there is a great mass of observational data. The evidence available indicates that the grazing is improved in conditions similar to those where the hay benefits, viz.:—

(*a*) On soils of boulder clay or heavy marl type;

(*b*) Where the land carries less than 3 sheep to the acre, or produces only some 30 lb. live weight increase per acre during the season.

The improvement may become so marked that 3 sheep to the acre can be carried and 120 lb. live weight increase be produced. Where, however, the natural herbage is already up to this standard, as is the case at Rothamsted and on many other second-class pastures, it is less certain that an increase will be obtained, though certain slags which cannot yet be characterised chemically are still capable of effecting an improvement.

(iii) On arable land the experiments have given less definite results. Where crop increases have been produced it has been in the root and clover breaks, which, however, would react on the intervening cereal crops.

The experiments will be continued, and the Committee proposes (*a*) to recast its experimental work at the end of the fourth year, so as to ascertain whether the slag can be caused to act in cases where at present no effect is visible; (*b*) to ask the Agricultural Education Association to continue their experiments for a further period of years, re-dressing the plots with slag at the end of the fourth year.

Standardisation of Sieve.—The Committee has carried out work on the effect of wear on the mesh of the sieve used to determine fineness of grinding and also on the question of the standardisation of the sieve.

As regards the effect of wear, used sieves examined at Rothamsted were found to deviate considerably from standard. Thus, in one case, 85 per cent. of the apertures exceeded standard by more than 10 per cent., while a stretch of 50 per cent., or over, was shown by 36 per cent. of the apertures. The effect of wear seems to depend very much on the type of weaving adopted. Where wires go over one, under one, the spacing is more rigid, although the wires break more quickly under wear. The weaving which may give a sieve a long life may also make it less reliable as a standard for grading purposes.

The sieve commonly used for determining fineness when any attempt at a definite standard is quoted is a German sieve, namely, that of Amandus Kahl, and designated 100 E. Another type of sieve has been standardised by the Institute of Mining and Metallurgy. which has for its basis that the diameter of the wire and the side of the aperture shall be identical.

The following are specimen measurements of such sieves :—

	Specimen	Wire mm.	Space mm.
Amandus Kahl 100 E	I	0·120	0·143
"	II	0·110	0·145
"	III	0·110	0·148
"	IV	0·126	0·142
Sieve used in Government Laboratory		0·102	0·150
Institute of Mining and Metallurgy—			
100 mesh		0·127	0·127
90 "		0·141	0·141
80 "		0·159	0·159

There is no statutory obligation to state fineness of grinding, but it is often stated.

The Committee has come to the conclusion that standardisation is necessary both in the interests of farmers and of the trade, and has drawn up the following specification for a standard sieve and method of use :—

(i) The standard sieve for determining the fineness of grinding of basic slag shall be of metal and circular in shape; it shall be mounted in a stout circular metal framework; the parts where the screen meets the framework shall be rounded off by solder, or otherwise, in order to avoid crevices in which powder may collect; the sieve shall be fitted with a lid and box underneath to collect fine material.

A convenient size of sieve is one with a diameter of 5 to 8 in.

(ii) The mesh of the standard sieve shall be of the "single weave" type, *i.e.*, each wire shall pass alternately over and under successive wires and at right angles to those wires.

(iii) The standard sieve shall be of even texture. The standard diameter of the wire and the standard length of side of the aperture shall be each 0.141 mm.; no wire shall anywhere be less than 0.138 mm. in diameter, and no aperture shall be greater than 0.155 mm. in length of side.

(iv) The operator shall manipulate the sieve in his own way, providing that no force or pressure of any kind shall be used to persuade particles to pass through the sieve. Sieving shall continue until all obvious signs of material still passing through have ceased.* A mechanical shaker may be employed. Soft lumps which can be caused to crumble by application of the fibres of a bristle brush shall be broken down after each shaking period, but in such manner as to avoid the hard parts of the brush coming in contact with the sieve so as to cause abrasion.

* It is suggested that a convenient procedure is to take 20 grammes of basic slag and transfer to the sieve with the lower receiver attached. After shaking for 10 minutes with occasional tapping of the sides of the sieve, all the fine material which has passed through into the lower box to be carefully brushed out into a suitable vessel and weighed. The shaking to be repeated for another 10 minutes and the sifted matter again removed, mixed with the first portion and weighed. The process to be repeated until not more than 0.2 per cent. is sifted during 10 minutes.

Sieves will not remain in accordance with paragraph (iii) if they are used for other purposes in which either pressure from above is used in the sieving process or coarse and heavy constituents are present in the material to be sieved.

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LICENSING OF STALLIONS UNDER THE HORSEBREEDING ACT, 1918.

IN the May issue of this *Journal* were published certain particulars in regard to the licensing of stallions under the Horse Breeding Act, 1918. The figures then available (up to 31st March, 1924) indicated that the steady decline in the number of stallions licensed under the Act would continue. This anticipation is confirmed by the complete figures now available for the licensing year ending 31st October, 1924. It will be seen from the Tables annexed that the total number of licences issued for the service season of 1924 was only 2,210, as compared with 2,761 in 1923 and 3,479 in 1922. The number of stallions refused during the year was 75, and the one satisfactory feature of the figures is that this number of refusals represents a much lower percentage than during any year since the Horse Breeding Act came into operation.

The following analysis of the number of stallions licensed shows that the decline is much more marked in the case of Shire stallions than among other breeds :—

Service Season.	1921.	1922.	1923.	1924.
Shires	2,463	2,174	1,634	1,195
Other Heavy Horses ...	636	591	486	424
Light Horses (including ponies)	717	714	641	591
Totals ...	3,816	3,479	2,761	2,210

The inference to be drawn from the above figures, of a serious decline in the breeding of horses, is confirmed by the particulars furnished in the Agricultural Returns of June, 1923, when the number of stallions used for service in England and Wales was returned as 5,459 as compared with 6,074 in 1922, while the number of foals returned has steadily fallen since 1920, the figures being as follows :—

1920.	1921.	1922.	1923.	1924.
97,298	92,269	83,890	66,323	54,700

It is desirable that this decline should be arrested as far as possible, and the Ministry hopes that something may be accomplished in this direction by the revival of grants to Heavy Horse Societies. It was not expected, in view of the late decision to reinstate the Heavy Horse Scheme last year, that the effect would be evident at once, but the encouragement given to breeders, especially the small farmers, should tend in the future to increase the number of stallions licensed.

In so far as the prevention of the use of unsound stallions is concerned, the Act appears to be achieving its purpose. The number of contraventions brought to light has steadily decreased year by year. During the year ended 31st October, 1924, thirteen unlicensed stallions were reported to be travelling for service, and eleven others, though licensed, were found to be travelling without licences. Police proceedings were taken in six cases, in each of which fines were imposed on the owners and leaders.

. Stallion owners in possession of licences for the year ended 31st October, 1924, are reminded that these licences expired on

Table II.

BREED.	Number of Applications.	Number of Refusals.	Per cent. of Refusals.	REASON FOR REFUSAL.									
				Roaring.	Whistling.	Sidebone.	Ringbone.	Cataract.	Bone Spavin.	Defective Genital Organs.	Shivering.	Stringhalt.	Defective Conformation.
Pedigree:—													
Shire ...	1,198	47	3·92	14	19	7	—	5	—	—	1	1	—
Clydesdale ...	153	5	3·27	1	1	1	1	1	—	—	—	—	—
Percheron ...	54	1	1·85	—	—	1	—	—	—	—	—	—	—
Suffolk ...	180	7	3·89	1	3	1	—	—	1	—	—	—	1
Hackney ...	152	4	2·63	1	—	—	—	—	1	1	—	1	—
Thoroughbred	152	5	3·29	1	—	—	—	1	1	2	—	—	—
Welsh Cob ...	68	1	1·47	—	—	—	—	1	—	—	—	—	—
Arab ...	20	1	5·00	—	—	—	—	—	1	—	—	—	—
Non-Pedigree:—													
Heavy ...	98	4	4·08	2	—	2	—	—	—	—	—	—	—
Total Refusals	—	75	—	20	23	12	1	8	4	3	1	2	1

Table I.

	Heavy Breeds					Light Breeds									Pony and Cob Breeds									
Pedigree Stallions:— i.e., Stallions entered or accepted for entry in the recognised stud book of their breed.	Shire	Clydesdale	Suffolk	Percheron	—	Hackney	Thoroughbred	Arab	Cleveland Bay	Welsh Roadster	Hunter	Yorkshire Coach	American Trotter	—	Welsh	Fell	Dales	Polo and Riding	Shetland	Highland	Dartmoor	Welsh Cob	—	
Licensed	1,151	148	173	53	—	148	147	19	7	1	4	1	—	—	28	24	16	27	5	—	—	67	—	2,019
Refused...	47	5	7	1	—	4	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	71
Applications	1,198	153	180	54	—	152	152	20	7	1	4	1	—	—	28	24	16	27	5	—	—	68	—	2,090
	Types					Types									Types									
Non-Pedigree Stallions:— i.e., Stallions not entered or accepted for entry in a recognised stud book.	Shire	Clydesdale	Suffolk	Percheron	Others	Hackney	Thoroughbred	Arab	Cleveland Bay	Welsh Roadster	Hunter	Yorkshire Coach	American Trotter	Others	Welsh	Fell	Dales	Polo and Riding	Shetland	Highland	Dartmoor	Welsh Cob	Others	
Licensed	44	2	2	1	45	30	2	3	—	1	4	—	8	11	7	2	10	—	—	—	—	16	3	191
Refused...	1	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Applications	45	3	2	1	47	30	2	3	—	1	4	—	8	11	7	2	10	—	—	—	—	16	3	195
Total licensed	1,195	150	175	54	45	178	149	22	7	2	8	1	8	11	35	26	26	27	5	—	—	83	3	2,210
Total refused	48	6	7	1	2	4	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	75
Total applications ...	1,243	156	182	55	47	182	154	23	7	2	8	1	8	11	35	26	26	27	5	—	—	84	3	2,285

that date and should be returned to the Ministry. Applications for renewal, as well as for new licences, should be made as early as possible on forms which may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

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APPLE PACKING STATIONS OF NOVA SCOTIA.

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THE apple industry of Nova Scotia is concentrated in a narrow valley not exceeding 7 miles in width, lying between the North and South Down Hills, which run from the small town of Windsor, N.S., down almost to the Bay of Fundy. This valley is popularly called the Annapolis Valley, though in reality it consists of three or four valleys—the Avon, Habitant, Cornwallis and Annapolis Valleys. From the look-out, a view point in the North Downs, one looks down on a fertile plain, watered by three rivers, and as far as the eye can see abundantly planted with apple trees. In blossom time the valley is said to be a panorama of beauty. The valley takes its name from Annapolis Royal, a small town situated near the Bay of Fundy, famous as being the place where in 1603 the first French Canadian fort and settlement were made, and which was evacuated and handed over to the English in 1704 in accordance with the terms laid down in the Treaty of Utrecht. It is believed that to the French settlers must be given the credit of first growing fruit in this district, though at the present time the Annapolis Royal orchards are old grass orchards of little use. Stage by stage the industry spread, and fruit trees were planted further and further up the valley until the area now extends for fully 100 miles right up to Windsor, besides branching up into the minor valley.

The names of Prescott and Col. Burbridge are associated with the development work. The former—a Scotsman—established at Star Point an orchard composed chiefly of English varieties, such as Wellington, Blenheim Orange and Nonpareil. Col. Burbridge was responsible for introducing further varieties, but more especially he is associated with establishing the practice of grafting, whereby it was made possible for the settlers to graft good commercial varieties on to the wild native seedlings.

Pioneers in other spots along the valley continued the work until a chain of fruit trees was planted through the entire length of the valley. This development was made by settlers from the Motherland and loyalists from the United States, though at the present time some of the orchards have been bought up by English fruit firms anxious to secure a supply of Dominion-grown fruit.

The soil is rich, light and of an alluvial nature, well able to give good tree growth. The rainfall is sufficient and the four rivers of the valley keep the subsoils well drained. The climate is cold in winter, with snow, the summers are moderately hot with bright sunshine, and the air is clear and somewhat relaxing.

The Orchards.—There is a great similarity in the lay-out of the orchards, since half-standard trees have been planted widely separated in rows fully 40 ft. apart. Some orchards are fully 80 to 100 years old, though the majority would be from 20 to 30 years, and a few are quite young. Grass orchards are not favoured, and all but the backward growers keep the land well cultivated with disc harrows from spring until the 1st of July, when seed of clover, vetches, rape, millet or buckwheat is sown to produce a green crop to shade the land and for ploughing in to provide soil humus. In addition the trees are given spring dressings of artificial fertilizers containing liberal quantities of nitrogen and acid phosphates and a little potash. Under this treatment and helped by the favourable climate the trees bear very large dark green leaves; they make sufficient but not abundant wood growth, packed with abundant plump fruit buds, which are said to develop good fruit crops every year.

The fruit growers are concerned only with the production of the apple crop, and on its successful results they depend for a livelihood, which to some extent explains the business attitude adopted by the growers in persistently pursuing methods of cultivation believed to produce the best crop.

Spraying.—The valley is by no means free from pests, and on neglected old trees scab and scabby blotch, the codling moth, brown tail moth and aphis can be found. No grower can afford to neglect spraying or but a small percentage of the crop would be fit for packing as Grade No. 1. It is said that most growers spray three or four times, and the best of them five or six times. The first spray consists of lime-sulphur

of 1·009 specific gravity or 3 gal. commercial strength to 100 gal. water (1 to 33), with the addition of arsenate of lime 2 lb. to 100 gal. This is put on at 200 lb. pressure when the trees are in the green bud stage. For the second spraying, just before the blossom buds have opened, weaker lime-sulphur (1 to 43) and arsenate of lime is used. The third spray, after the petals have fallen, consists of lime-sulphur 1 to 50 and arsenate of lime 1½ lb. to 100 gal. Two weeks later the fourth spray is used and this consists of Bordeaux mixture (7 lb. copper sulphate, 7 lb. quicklime to 100 gal.) with 5 lb. paste lead arsenate added to each 100 gal. In very wet seasons a fifth spray, similar in material to the fourth, is used two weeks later to control apple scab.

The result is that large crops of clean fruit with high skin finish are produced annually, and growers gather a high percentage of Grade No. 1 and No. 2 fruits with but a small quantity of culls.

Picking and Packing.—Seasonal staff is engaged for picking the fruit, a process which has to be done carefully, for no windfalls, dropped or bruised apples can be packed or the barrels arrive " slack " in the market and sell at a low rate. In the orchards the picked fruit is placed into barrels (capacity 3 bus.). These are temporarily headed in and marked with the grower's name, when they are ready for delivery to the packing station. The barrels containing the " orchard run " apples are not considered ready for the market, nor can they according to the Fruit Act of Canada be sold until the apples have been properly graded and packed and the barrels marked " Grade No. 1, No. 2, Domestic, or No. 3," as laid down in the regulations. Growers are allowed to sell the orchard run fruit to dealers or speculators, as they are called locally, provided the grading and packing are carried out by these men. Growers with 70-100 acres have their own packing houses of sizes sufficient for storing and handling the crop, but the majority of the growers adopt a co-operative method of packing and selling and for that purpose have formed a number of societies or companies, each of which owns one or more packing houses.

In the packing houses of the speculators, private growers, or co-operative societies the barrels of fruit are stored to await grading, packing and marketing. At the time of the writer's visit, Gravensteins, Blenheims, Ribstons and Cox's Orange Pippins—all classed as early varieties by the Nova Scotian growers—were being handled quickly for early marketing. The

apples from the barrels were emptied into mechanical graders where they were sized into four sizes, which for the Gravensteins were 2½ in., 2¼ in., 2 in. and culls. For other varieties, different sizes were adopted. A team of girls then sorted the apples in each bin, removing from the 2½ in. fruit any that had less than 40 per cent. of colour, or more than 10 per cent. of blemishes. These rejected fruits were placed in the domestic grade, which normally contains large lightly coloured fruit, or those which have a proportion of blemishes. The well-coloured clean fruit remaining constitutes Grade No. 1. Some of these were taken and carefully ringed in the bottom of the barrels to give a good face, and then the bulk fruit was lowered on sacking aprons from the grader bin down into the barrels in quantities of 12 to 15 lb. at a time. The second and third grade of apples were similarly dealt with, though the standard of colour and freedom of blemish was a lower scale.

With a good sample of fruit the mechanical grader was kept running continuously, that is the orchard run fruit passed in at one end and the barrels of Grade 1, 2, Domestic, 3 and culls were being packed along each side at the other. The filled barrels were moved away from the grader to a "wracking" plank where they undergo a process of vigorous shaking to secure a tight pack. A top layer of apples was ringed, a collar of thick paper applied, and the head of the barrels forced into the proper grooves by pressure and kept in position by hoops and nails. The end of the barrel was stencilled with the name of the packer or packing house, the variety of apple and the grade. Bulks of barrels of each grade were packed into railway vans which stood alongside the packing house ready for despatch to Halifax to catch the steamship to England.

Government Inspection.—During the whole time that the staff are working in sizing, grading, packing and marking, the operations are subjected to visits by inspectors from the Fruit Branch of the Department of Agriculture. If in the opinion of any inspector, the work is not being done to conform to the conditions laid down in the Fruit Act, the barrel is marked "Overfaced," "Under Grade," "Undersize" as the case may be, and the packer is reported to the Department for their consideration for prosecution. The report of the inspector records the number of packages examined, the marks on the packages, the detailed results as to colour, size and defects, the temperature of the apples and of the packing station. In the case of violation of the Fruit Act, the inspector hands a copy of his report to the packer.

The Packing Houses.—Throughout the Annapolis Valley there must be over a hundred of these packing houses, the majority of which are built alongside the railway lines so as to give easy loading. At Berwick Station there are seven such houses and a smaller number at each of the stations of Waterville, Aylesford, Kingston, Middleton and Wolfville. The average house is frost-proof, and well constructed of wood and fibre; it has three stories of which the top and bottom are used for storage purposes and the middle floor for storage and packing. The size of the house varies from 165 ft. by 40 ft. (The Fort William) up to 265 ft. by 60 ft. (The Berwick Fruit Co.), in accordance with the output that has to be handled. Each house is equipped with a locally made mechanical grader (though one had a Cutler machine), a barrel press, copper plates for stencilling the barrels and elevators for taking the full barrels of fruit from the storage rooms to the packing floor. A part of the end of the packing house is partitioned off to provide office accommodation for the manager and his clerks. The average capital cost of a packing house would be from £2,500 to £3,000, and this is provided by the members of the society, which for this purpose trade as a limited company registered under a Provincial Act of Parliament. The Berwick Fruit Co., one of the largest, owns an exceedingly large packing house which packed and sold 51,390 barrels and 1,010 boxes of apples in 1923.

All the packing companies operate under specific by-laws. These, however, show a great similarity in requiring (*a*) that all apples grown by any shareholder shall be handed over to the packing house for packing and disposal, (*b*) that any shareholder who shall dispose of any apples grown by him, otherwise than through the company, shall pay the company 10 to 25 cents (5d. to 1s.) per barrel for all such apples, (*c*) that payment shall be made for apples in accordance with the average price obtained for each variety, and (*d*) that the expense necessary for running the business of the company shall be collected from members on a basis of so much money per barrel. The conduct of the business is invested in a Board of elected directors who have powers to appoint a permanent manager as head of the packing house, and clerks to assist in the office. A team of packers to operate one grading machine continuously would consist of six or seven men and seven or eight girls—a force of thirteen to fifteen people. The wages of these packers would average from 9s. 6d. to 10s. 6d. per day, with an additional sum

to the foreman. Such a team would be able to grade, pack and despatch from 300 to 350 barrels per day at a cost for grading and packing of about 9d. to 10d. per barrel. The staff is engaged for the season, which commences in September and continues until the end of March.

Each manager of a packing station has to keep an accurate statement of the grading of each member's fruit for the purpose of making the proper payment to him, in accordance with the grading of his delivered fruit. This is important, for great divergencies are revealed, as instanced by the following figures taken from the books of some of the packing houses :—

Grower A—Total Gravenstein crop, 1924, graded into No. 1, 76 per cent., No. 2 14 per cent., Domestic 7 per cent., No. 3 3 per cent.

Grower B—458 barrels of poor fruit graded one day into 130 grade 1, 300 grade 2, 6 Domestic, 11 grade 3 and 11 culls.

The apples of each grower are graded separately and each receives a return according to the merits of his deliveries as revealed by the office books—though as a matter of fact the poor samples of fruit require more handling in grading and cost more in labour and time.

The United Fruit Companies of Nova Scotia.—The Berwick Fruit Co., in common with some of the other companies, make their own arrangements for shipping their barrels and selling them in the English markets, but 40 other companies have carried co-operation to a stage further by combining to form a central trading organisation registered as "The United Fruit Companies of Nova Scotia," which has now reached its thirteenth year of existence. The United Fruit Companies acts as a selling agency for all its subsidiary companies, and has a permanent manager who arranges for the railway and shipping transport and the selling of the apples in the world's markets, either directly or through commission agents. According to the annual report for 1923, this central company sold 481,142 barrels, or about one-third of the total production in the Nova Scotia area. In the report there are also given figures of the average prices realised for the several grades. These were as follows :—

Variety	No. 1	No. 2	Dom.	No. 3
Baldwin	$3.34	$2.48	$2.47	$1.21
Blenheim	2.73	2.18	1.93	1.02
Gravenstein ...	3.17	2.76	2.48	1.51
Golden Russet ...	4.29	3.67	3.05	2.48
Kings	3.31	2.77	2.45	1.66
Ribston	2.32	1.99	1.48	1.10

These figures show the substantially higher returns in the British market from the higher grade fruit—a point of importance, considering that the cost of production is higher for the better grade. The United Fruit Companies help the subsidiary companies in utilising the windfalls, bruised and cull apples, for which purpose it has established a subsidiary company which operates a factory at Aylesford for the manufacture of such apples into vinegar, cider, canned apples and dried apple rings. This factory in 1923 produced 25,000 gallons of vinegar, 91,000 gallons of cider, 125,352 gallon cans of apples and 361,675 lb. of evaporated apples, and so turned to profitable account a large bulk of low-grade fruit.

Arrangements are made by the central organisation for the purchase in bulk of artificial manures and spraying materials for distribution to the members of the subsidiary companies, and in 1923 the quantities of fertilisers alone amounted to over 3,000 tons.

Conclusion.—This method of packing and selling fruit cooperatively through fruit companies is said to have been started by five growers in 1904, who established a small packing house at Cambridge, Nova Scotia. The advantages were so quickly apparent that the practice spread, and in the short space of 20 years packing houses have been built throughout the valley, so that the total output of fruit, which exceeds one and half million barrels annually, is properly prepared in the packing houses in accordance with modern market requirements. The method has fostered and encouraged a spirit of co-operation, and fully 60 per cent. of the output is marketed under this system. The industry has been helped by the Dominion Fruit Act, which makes grading and packing a compulsory and necessary operation. This very practical Act is wisely administered by the Dominion Fruit Commissioner with the help of a large staff of inspectors, all of whom are daily engaged in encouraging, aiding, stimulating and compelling packers to conform to the practice which will bring the best market returns and also build up a reputation for honest packing for the apples of Nova Scotia.

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POTATO LEAF-ROLL.

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ALTHOUGH the potato was introduced into Britain during the latter half of the sixteenth century, it was not widely cultivated until some time after the middle of the eighteenth. Not long after this, and for a period which extended for a decade or so into the nineteenth century, there were many complaints by growers of serious losses in the crop owing to a disorder which was called "The Curl." Much was written and many and diverse views were held as to the nature and cause of The Curl, and suggestions for obviating it were not wanting; nevertheless its true nature remained uncertain. After about the year 1812 the importance of The Curl appears to have declined; and, before the middle of the nineteenth century, a new potato scourge which completely overshadowed The Curl made its appearance, namely, "blight."

At about the beginning of the present century there arose, particularly on the Continent of Europe and, later on, in Britain and elsewhere, renewed complaints of a disease in potatoes of somewhat the same general type as that formerly known as The Curl. This disease, like The Curl, was characterised by more or less serious diminution in yield and general deterioration, degeneration or "running out" of stocks: by stunted growth and the curling or rolling of the foliage. This was called the Leaf-Roll disease. At first it was thought to be due to a parasitic fungus, but, later on, this view was abandoned.

Largely in consequence of the alarm raised, potato diseases have been studied more intensively since that time; and one result has been to show that The Curl was not a single specific disease, but consisted of several distinct maladies, some of them more or less closely akin to one another, but others clearly different in nature. Leaf-Roll is one of these diseases; and the name Curl is still occasionally applied to it, but only in this country. Owing to the lack of preciseness with which the term Curl has been used in the past, however, it is not desirable to retain this name now for any one of the specific diseases which were formerly included under it.

Distribution of Leaf-Roll.—Leaf-Roll has a world-wide distribution, and is probably to be found to some extent wherever potatoes are cultivated. In Britain it is very prevalent on the lighter soils of the southern and drier parts of the country, and its ravages are apt to be particularly severe in those districts

when locally-grown seed is planted. It is, however, by no means confined to such localities, and in recent years it has become increasingly obvious further north. Even in Scotland it is far from being a negligible factor—perhaps, indeed, it is one of the most important factors—in the successful production of potatoes, especially those destined for seed.

Susceptibility of Varieties.—Although nearly all varieties are liable to Leaf-Roll, some appear to be more subject to it than others. It is particularly common and severe in such first earlies as Midlothian Early (Duke of York) and May Queen. Sharpe's Express also suffers, but not so seriously. Of second earlies, British Queen is liable to severe attack, and of main crop varieties Up-to-Date and King Edward. President (including Scottish Farmer and Iron Duke) is also particularly susceptible.

Of first early varieties which appear to be somewhat resistant, Epicure, Eclipse and Ninety-Fold usually suffer less than those named above, whilst Resistant Snowdrop (Witchhill), a variety immune to Wart Disease, appears to be very highly resistant to Leaf-Roll. Of later varieties, Arran Chief, The Ally, Templar and especially Great Scot are seldom seriously attacked.

Losses due to Leaf-Roll.—The general effect of Leaf-Roll is shown by a serious reduction in yield, the average size and number of tubers produced being usually much diminished. Moreover, this effect is passed on to succeeding generations through the tubers produced by diseased plants. It will therefore readily be understood why Leaf-Roll is classed amongst those diseases of the "degeneration" or "running out" type.

A clear idea of the losses which may be caused by Leaf-Roll can be gained from the results of a series of experiments carried out by the Ministry in 1921. Healthy seed potatoes and others derived from a crop suffering from Leaf-Roll were grown side by side, under identical conditions, in ten different localities in England and Wales. The diminution in yield on the Leaf-Roll plots varied from 21 to 63 per cent., and the average loss was nearly 51 per cent. Other experiments, carried out in the two following years, showed losses of over 45 and over 52 per cent. respectively. Such extensive losses are to be regarded as quite normal in crops derived from tubers the whole of which are infected with the disease. Where partly healthy and partly diseased seed is employed the immediate losses are naturally not so great; but since the effects of the disease are cumulative, owing to its being perpetuated through the seed, the ultimate losses are bound to be very great.

(*Photo*: *P. A. Murphy.*)

Potato Leaf-Roll in "Golden Wonder," showing rolling confined to the lower leaves. Tubers from such plants should not be used for seed purposes as they will give rise to diseased plants which will yield a very poor crop.

Symptoms of the Disease.—Plants which have only quite recently become infected may show no signs whatever of such infection; and this may be the case throughout the remainder of the season. That such plants really carry the disease, however, will be evident in the following season when the symptoms of Leaf-Roll will appear in their progeny. It is perhaps only when healthy plants become infected comparatively early in the season that unquestionable symptoms of Leaf-Roll appear in that season. Such symptoms will then be shown primarily, if not exclusively, in the new parts which have developed since infection took place, that is in the upper parts of the plant.

The characteristic symptoms of the disease are most marked in plants produced by the tubers of diseased plants of the previous year. In such plants the lower leaves, especially, exhibit at a comparatively early stage a rolling upwards and inwards of the margins of their leaflets, the rolling being at first more pronounced at the bases of the leaflets than at their tips. (See illustration.) This rolling may spread to the leaflets of the upper and younger leaves as the plant develops, so that the whole foliage eventually may have a "rolled" appearance. Sometimes, however, this rolling of the upper leaflets does not occur or is not strongly marked, and the importance for diagnostic purposes of the rolling of the leaflets of the lower, first developed leaves is very great. It assists, for instance, in distinguishing Leaf-Roll from Verticillium Wilt, Black Leg and other diseases.

The leaflets are often thicker, more crisp and drier than normal; and when knocked together they make a rattling sound. The midribs of the leaves frequently point upwards at a somewhat acute angle, and this gives the whole plant a somewhat stiff, gaunt and V-like appearance. The whole plant may also be much reduced in size, and in severe cases it is often quite dwarfed and reduced to a single small stalk.

Associated with the rolling of the foliage colour changes often occur, especially in particular varieties. Thus, in President, in Crusader, and to some extent in Kerr's Pink, a reddish colour occurs. Seen from a distance plants affected with Leaf-Roll often appear pale because the lighter, under-surfaces of the leaflets are exposed to view instead of the darker upper-surfaces. Dark brown or black areas of dead tissue are sometimes prevalent on the leaves of plants affected with Leaf-Roll, but they are not necessarily characteristic of this disease.*

*Sometimes a potato plant affected by Leaf-Roll may suffer simultaneously from one or more other diseases. In such circumstances diagnosis is often extremely difficult.

The tubers produced by plants affected with Leaf-Roll are fewer in number and smaller in size, on the whole, than those produced by healthy plants. The old set or seed usually remains in the soil undecayed; but this is by no means an infallible sign of the disease. No certain means have as yet been found for detecting the presence of the disease in the tubers, and diseased tubers cannot be distinguished from healthy ones except by growing plants from them.

As regards internal symptoms of the disease it is found that the rolled leaflets contain an excess of starch. It seems probable, in fact, that the mechanical rolling of the leaflets is more or less directly caused by the great accumulation of starch grains in their cells. In healthy leaves the starch manufactured in daylight becomes converted into sugar during the hours of darkness, and possibly also to some extent at other times. This sugar is carried away through the conducting tissues in the leaf-stalk and stem, and reaches, on the one hand, the newly developing tubers, where it is converted back to starch and deposited as reserve food, or, on the other, the growing points of roots and shoots, where it is available for the development of new growth.

In the leaves of plants affected with Leaf-Roll, however, this normal process of food manufacture, followed or accompanied by translocation, is upset. Heavy congestion of starch occurs in such leaves; and, even after prolonged darkening, it is found that this starch has not become translocated. Further, certain parts of the food-conducting tissues of the leaves and stems of plants suffering from Leaf-Roll sooner or later become disorganised and incapable of functioning normally. It is this combination of starch congestion in the foliage with failure in the channels of transport which prevents the green leaf from continuing to manufacture the food necessary for further growth or required for storage purposes. This appears to be the fundamental reason why plants affected with Leaf-Roll are limited both in growth and productivity.

Cause and Transmission of Leaf-Roll.—Perhaps the most important discovery made in recent years concerning Leaf-Roll (and also concerning Mosaic and some other degeneration diseases) is that it is a *transmissible disease*, and that it can be transferred readily from a diseased to a healthy plant. Such transmission can be carried out artificially by grafting either a scion or a portion of a tuber from a diseased plant on a healthy stalk or portion of tuber respectively. But transmission occurs more readily still by means of sucking insects, such as aphides

(green fly). When aphides which have been feeding on diseased foliage proceed or are transferred to healthy leaves, they infect the latter; and, although no immediate sign that infection has taken place may become apparent, yet when tubers of such plants are used for seed the resulting plants will be found to be affected with Leaf-Roll.

In the field it is believed that aphides are the natural means by which Leaf-Roll is spread, and it is clear that in localities where these insects are prevalent, provided diseased plants are at hand, spread will be most rapid and most intense. There are some grounds for suspecting that other classes of sucking insects, such as Capsid Bugs and Leaf Hoppers, may play the same rôle as aphides do, but more evidence is required before this can be regarded as fully established. It is believed that Leaf-Roll cannot be contracted directly from the soil, but the problem as to whether transmission from diseased to healthy plants naturally occurs underground through the agency of insects or other means has not yet been definitely solved.

It is important to note, however, that the spread of Leaf-Roll through the agency of aphides is not necessarily confined to the field. It may also occur during storage, particularly amongst seed tubers boxed for sprouting. Aphides not infrequently infest the sprouts of such potatoes in store, and if, after having fed on the sprout of a tuber from a diseased plant, they migrate to the sprout of a healthy tuber and feed there, they convey infection, and the plant arising from that tuber will be affected with Leaf-Roll.

As to the nature of the material or substance that is transmitted to and causes Leaf-Roll in a previously healthy plant, little or nothing is at present known. The plant juice which carries the infective principle may be passed through the pores of a filter which holds back all ordinary fungi and bacteria, and yet retain its power of infectivity. The active principle is at present generally referred to as a *virus*, and if—as there seems some reason to suppose—the virus is some kind of organism, the dimensions of the latter, during part of its life cycle if not during the whole of it, must be ultramicroscopically small. It may be added that the part played by aphides in transmitting the disease is believed to be a purely mechanical one, and that the virus undergoes no change in the insect's body. In its search for food from its host plant an aphis reaches with its proboscis the phloem or bast of the vascular tissue, that is, just the tissue usually regarded as being devoted to the conduction

of manufactured plant food. The fact that this particular tissue becomes disorganised in plants affected with Leaf-Roll is significant, and suggests that the intimate association of the virus with the phloem is of considerable importance in this disease. When once inoculated into the plant the virus sooner or later permeates the whole of it, and for this reason Leaf-Roll is to be regarded as a systemic disease.

Measures of Control.—There is no known cure for Leaf-Roll, and the only certain means of avoiding it is to ensure that none but tubers from healthy plants are used for seed, and that the plants arising from them are protected from extraneous infection during growth.

The following are some of the measures to be adopted in controlling Leaf-Roll disease, and they apply to other potato degeneration diseases such as Mosaic, Crinkle, etc. :—

1. *Rejection of all Infected Plants for Seed Purposes.*—Since the disease is perpetuated by means of the seed it is of the utmost importance that no seed should be saved from affected plants. Not only should tubers from dwarfed plants and from plants with obviously rolled foliage be rejected for seed purposes, but so also should tubers from all plants showing rolling in the lower leaves only and—at all events in the south—those from even apparently healthy plants in proximity to diseased ones.

In the case of gardens and small holdings, the common practice of allowing the entire crop of healthy and diseased plants to mature and then selecting tubers of seed size from the produce cannot be too strongly condemned. No seed should be saved from any crop which shows any considerable proportion of plants suffering from Leaf-Roll in it.

2. *Rogueing and Early Lifting of Seed Crops.*—Where potatoes are specially grown for seed purposes, thorough rogueing of the crop each season should be made a definite routine practice. This should be begun as early as possible, that is, as soon as diseased plants become definitely recognisable, since in some seasons aphis transmission begins early. It should be repeated if necessary. By this means the centres from which infection is carried can be suppressed. If the work be done before any new tubers have been formed, no digging will be required, the plants, with the seed piece, being simply pulled up and destroyed.

Although, as already explained, the disease is a systemic one, a certain period of time—it may be a very short one—must elapse subsequent to inoculation with the virus, before the latter reaches every part of the plant. By early lifting, therefore, it may be possible to secure some healthy tubers from recently

infected plants. There is no doubt that thorough and persistent rogueing begun early, together with early lifting, are the most important factors which are likely to contribute to success in obtaining seed free from Leaf-Roll.

3. *Special Precautions in the South.*—In the southern and drier counties special care is required as to seed. In fields and large plots, if healthy northern seed has been used and the crop is entirely free from Leaf-Roll, seed may usually be saved safely for one season, and a good crop be the result in the following one. If Leaf-Roll appeared, however, even to a slight extent, no seed should be saved unless the crop was promptly and efficiently rogued, since an increased amount of disease will be evident in the following season. In small gardens and allotments where the risk of transmission from diseased plants situated in neighbouring plots is exceedingly great, seed should never be saved, but a fresh healthy stock should be obtained each year from a reliable northern source.

4. *Control of Aphides.*—Control of aphides in the field to such a degree as to render Leaf-Roll transmission by them inoperative is impracticable. Where, however, aphides infest sprouting potatoes they may be suppressed by exposing the tubers in their sprouting boxes to a fumigant in a closed room or store. Good results are reported from the use of tetrachlorethane. This liquid may be employed at the rate of about half-a-pint per 1,000 cubic feet space. It is distributed in saucers on the floor, and the room or store is then tightly closed for two or three days, at the end of which time the aphides will be dead. On opening the store it should be well ventilated to get rid of the tetrachlorethane vapour before work is commenced in it.

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DECEMBER ON THE FARM.

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Seasonable Operations.—December is not ordinarily a month of rapid progress with field operations. Attention to live stock, now housed, or requiring supplementary rations if out of doors, occupy part of the labour, while the hours available for land work are limited by the diminished duration of daylight, the normally wet state of the land, and the impossibility or the inadvisability of extensive sowings at this time of the year. Wheat and oats drilled at this season may lie dormant in the soil for many weeks; indeed some farmers prefer not to sow at all in this month.

Formerly it was a rule of good husbandry that the manure yard should be emptied out once before Christmas; the modern farmer, however, endeavours to keep it empty. He recognises that the proper place for manure is on or in the soil; and he knows that where the yard is not covered in, heavily littered and used as a cattle-fold, manure should be carted direct from the shippons to the land. Nowadays good farmers do not view with unconcern a mound of manure occupying the central position in the farm quadrangle. If daily carting is impossible, so that there must be a heap somewhere, the heap is placed out of sight; and the dangerous and unsightly pit hole in the centre of the yard is filled in. Such improvements as this can be effected only in the winter months.

Winter Ridging.—On some of the strongest red marl soils of south Derbyshire, winter ridging is considered indispensable to the preparation of a tilth for mangolds. Laid up in ridges 24 in. to 27 in. apart, the land lies comparatively dry and well aerated throughout the winter; and, if the centre of the ridge is not disturbed near sowing time, the top soil, in which the seed is deposited, is free from coarse unweathered clods and the under soil is firm and moist. The yard manure is applied during frost and covered by splitting the ridges back over it. Where possible the ridges are split back once or twice before manuring. On this class of land, cleaning operations cannot as a rule precede the drilling of the mangold crop: an occasional bare-fallow is therefore necessary.

Unploughed stubbles, not too foul with twitch, may be manured and ridged up by raftering—*i.e.*, forming ridges by ploughing a deep furrow every 24 in. to 27 in. These rough ridges weather down somewhat during the winter and later may be put into better shape, without, however, disturbing their base.

Deep grubbing between ridges in winter is a form of subsoiling sometimes practised. As with other methods of subsoiling, its value, if any, can be determined only by actual trial on the land under consideration.

Dairy Farming: Labour and Crops.—On a well-organised and well-managed milk producing farm, the staff of labour is as fully employed at one season of the year as at another. Milking makes a uniform labour demand throughout the twelve months, and generally the staff required to milk and tend the cattle suffices for all other necessary operations on the dairy

holding. Where sufficient reasonably good pasture is available, this forms an economical ration for the herd during the summer, and its replacement by arable crops is not here suggested. While the cows are at grass the men during the greater part of the day are available for and may be fully employed in the cultivation and harvesting of crops required for winter feeding.

Under Midland conditions, a satisfactory distribution of the labour requirement of the farm and a suitable balance in the apportionment of the land are obtained where about 50 per cent. of the holding is fair pasture, 25 per cent. meadow and 25 per cent. arable, including about six acres of roots and cabbage. In developing the resources of the farm, the first step is to fertilise the pastures, so increasing their stock-carrying capacity. This result creates the problem of how to increase to a corresponding extent the farm's capacity to support the stock in winter. One solution is to graze a smaller area of pasture and grow more hay for winter; the better method, however, is to extend the arable acreage, especially that of the root crops, at the expense of less productive meadow hay land. A 20-ton crop of roots produces about three times as much nutriment as a 30-cwt. crop of hay, and much heavier yields of roots are obtainable by good treatment.

The above may not be a popular doctrine, especially in districts where land is so deficient in lime as to be infertile under arable crops; and as regards roots it is contrary to the general tendency as shown by the Ministry's statistics for England and Wales as a whole. In Derbyshire, however, the root and cabbage acreages in 1923 and 1922 were greater, and the permanent hay acreage considerably less, than in 1913 and 1912; and the adoption (with the aid of lime) of the principle here advocated is a distinguishing feature in the management of certain holdings in the county where better financial results are being obtained than on surrounding farms. In one case the acreage of roots has been so increased and that of the meadow hay so reduced that the ordinary winter ration of the herd includes 70 to 80 lb. of roots but only 10 to 12 lb. of hay: on this upland holding of 110 acres, the cattle stock is 40 cows and heifers and about 40 young cattle, which is about double the rate of stocking on other farms in the district. This particular land supported less than 30 cattle of all ages under previous management.

The desirability of a liberal root allowance but a limited ration of fodder in the cow's ration was explained in a previous article

in this *Journal*.* Further support of this principle may be found in another article† to which my attention has been recently directed, in which it is stated that Mr. F. B. May, of Heybridge, fed Eske Hetty, Hedges Moss Rose, and the rest of his herd of exceptionally heavy milkers, on a winter ration of 84 lb. of roots, concentrates at the rate of 3½ lb. per gallon of yield, but with no fibrous fodder whatever in the diet. It may also be observed, from the returns of the milk recording societies reported on p. 563 of the September issue of this *Journal*, that the highest average yields per cow have been attained in the arable counties—Bucks, Norfolk, Essex and Cambridge, not in the hay-growing districts, hitherto regarded as most suitable for dairying.

The acreage of arable land that can be cultivated by the regular staff of a dairy farm depends—among other considerations—on the organising capacity of the farmer, his equipment and his methods of root culture. In some cases the work of feeding the cows during the winter is made so laborious that the men have little or no time for outdoor operations, such as ploughing, manuring, hedge-cutting and ditching. Arrears then accumulate, and even in suitable weather spring cultivations cannot have sufficient attention until the cattle again begin to go out to grass. Under such conditions the cultivation of 25 to 30 per cent. of the farm for arable crops is more difficult and less satisfactory than it need be.

Winter feeding is often unnecessarily elaborated by dividing the day's ration into many small portions, served at intervals during the day. Equally good, if not better, milk yields are obtained by serving most of the food in the morning before 10 o'clock, leaving the cows to ruminate during the rest of the day and thus liberating the men for other duties until the evening milking. Pulping, chaffing and mixing are often made to occupy much time between the hours of feeding, whereas these operations are generally superfluous. Cows are able to grind whole roots: I know farmers who have successfully fed whole roots during their entire farming career and others who have abandoned pulping after trying whole-feeding. Chopping fodder is questionable policy, and mixing chaff with root pulp and concentrates is against the evidence of the Garforth feeding experiments. Moreover, concentrated foods cannot be correctly proportioned according to milk yield if first mixed with root pulp.

* This *Journal*, February, 1924, p. 1107.

† "Possibilities of the British Friesian," G. S. Scott Robertson, May, 1919.

MANURES FOR DECEMBER.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

The Use of Lime and Limestone.—It is gratifying to observe the marked revival in interest in liming, and Dr. Ruston's recent article in this *Journal** points the way by which in many instances the financial difficulty can be overcome. Much of the present cost of liming is due to transport charges, and if these can be diminished by opening local lime-kilns, the possibilities of improving the land become much increased. Lime shows to greatest advantage on arable land, but in addition it is often useful on grassland, when the soil has become too sour to allow basic slag to exert its full effect.

To what Field should Lime and Limestone be applied?—At a recent farmers' meeting which the writer attended, there arose a discussion whether lime or limestone should be applied to land receiving farmyard manure. Generally speaking it should not; it is more effectively given to the corn crop in which clover is being sown, or to any swedes or turnips which are being grown without a dressing of farmyard manure. Care should also be taken to apply the lime or limestone as far from the potato crop as possible; it should be given immediately after the potatoes, or not later than the second succeeding crop. The reason is that potatoes do not particularly stand in need of lime or limestone, and therefore can do quite well without it, while one of the scabs affecting the potato is encouraged when lime is added.

Does Wheat need Lime?—A farmer who is applying limestone to his land asks whether it should go on to the wheat, the oats or the barley. Of these three crops oats can best tolerate lack of lime, wheat comes next, and barley stands most in need of it. One can therefore expect the best results by applying the carbonate of lime to the land which is to receive barley.

The Time of Application.—Several farmers have raised the question whether lime or limestone should be applied now and ploughed in even though the land be wet, or whether the application should be deferred until the spring.

It is probably best to apply the material now, as soon as it is possible to get on to the land without injury. There is no necessity for ploughing in; that operation can wait for the normal

*November, 1924, p. 738.

course of cultivation. If heavy rain should come after the lime or limestone has been put on to the surface, its only effect will be to wash some of the substance into the soil.

Liming for Lucerne.—The writer has recently had occasion to visit Canada and the United States, and has been greatly impressed by the marked attention now being devoted to the lucerne crop. Regions and States where it was almost unknown a few years ago are now taking a lively interest in it, and Experimental Stations are laying down tests of varieties and of treatments calculated to give the best results. The Royal Agricultural Society of this country is equally alive to the possibilities of this crop, and cordially welcomed and supported the efforts of the Rothamsted Experimental Station to press forward with the problem of inoculation, which is one of the factors in securing a good take. Field experiments are now in hand in various parts of the country, and it will soon be known how far north the crop can be grown with certainty, and exactly what benefit can be expected from inoculation. One fact, however, has been abundantly demonstrated in Denmark, in Canada and in the United States; that the crop will not do its best on a soil which is deficient in lime. Whenever it is intended to grow the crop therefore, steps should be taken to ascertain whether the soil contains enough lime for the purpose. No great amount is necessary; a soil that effervesces on addition of acid certainly contains enough. Even if there is no effervescence, the soil may be sufficiently well supplied provided there is no indication of sourness.

Slag on Grassland: Failure to Act.—Several farmers have raised the question what should be done to grassland on which slag fails to act.

There are a number of cases in which this happens. Perhaps the commonest arises on second-rate grassland which is already producing about as much crop as the climate and the nature of the soil permit. At Rothamsted a field of this type already producing 25 cwt. of hay per acre, and giving a live weight increase of about 60-90 lb. in sheep per acre, is not improved by dressings of slag. This is an illustration of the well-known fact that soil productiveness may be limited by a number of factors of which the supply of plant nutrients is only one. If improvement of such land is desired for any reason it must be sought in other directions.

Another instance of failure to produce an adequate return is on light land insufficiently supplied with moisture, or on certain types of light hill soils. Here the remedy is to supply kainit

as well as slag; improvement frequently results. It is never certain, however, that this is going to pay, and no one should embark on extended treatment of this kind without having made the necessary small scale test.

The third case of failure is seen on very sour soils, such as have been reported in the West Riding of Yorks.* The remedy is to add lime or limestone in addition to slag.

It should be pointed out, however, that slag may fail to increase the bulk of herbage, and yet so greatly improve the quality as to justify its use. Mere records of weights of hay do not give a sufficient indication of the value of slag.

* For description of one of these, see "Observations on the Improvement f Poor Pasture in the West Riding of Yorks," by J. C. and D. A. Lynn, *ournal of Economic Biology*, Vol. XI, No. 2, July, 1924.

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending November 5th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	13.17	13.12	13. 7	17. 3
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13. 3*	13. 3*	13. 3*	13. 3*	(N)12. 8
„ „ „ neutral (N. 21.1 per cent.)	14. 6*	14. 6*	14. 6*	14. 6*	(N)13. 7
Kainit (Pot. 12½ per cent.)	...	..	...	2. 2	3. 5
French Kainit (Pot. 14 per cent.)	2.15	2. 6	2. 5	2. 5	3. 3
„ „ (Pot. 20 per cent.)	2.19	2.11	...	2.10	2. 6
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.10	2. 7	2. 4
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	6.10	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	11.10	11. 5	4. 8
Basic Slag (T.P. 30 per cent.)	3. 2	...	2.12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 7	1.11
„ (S.P. 30 per cent.) ...	3 5	3. 5	3. 8	3. 1	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8. 7	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	7. 7†	6. 0	6. 2†	...
Fish Guano (N. 7½-8¼, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ...	...	...	...	13. 7	...
Burnt Lump Lime	1. 8	1.17	1.18	2. 2§	...
Ground Lime	1.14	2. 5	2. 8	1.16§	...
Ground Limestone	1. 1	...	1. 4	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

MONTHLY NOTES ON FEEDING STUFFS.

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The Feeding Value of Egyptian and Bombay Cotton Cakes.—In the production of cotton, the cotton seeds, which consist of oval dark-brown seeds about the size of a pea, constitute a valuable by-product. By the ginning process, the cotton, which adheres to the seed coat in the form of fibres, is removed, and the resultant seeds, which are rich in oil, are ready for the crusher. In the ginning process, small tufts of short filaments are left adhering to the seed coats. In the Bombay seed these filaments form a close felt-like mass surrounding the entire seed coat; in Egyptian seed they form a little tuft at one end of the seed only. Examination of the seed at this stage will show that it consists of a brittle outer coat enclosing a loose oily kernel. These outer coats, or hulls, have approximately the feeding value of wheat chaff, and in some cases are removed before crushing takes place. The cake resulting from the crushing of these kernels is known as decorticated cotton cake.

As a general rule, however, the whole seed is crushed, with the result that two main types of undecorticated cotton cake are available for use, viz., Bombay cotton cake and Egyptian cotton cake. Owing to the difference in original composition, the Bombay cotton cake contains a little more cotton fibre than the Egyptian cotton cake. When first introduced the presence of these fibres was very obvious, but with the improvements in the ginning process that have taken place, the difference between Bombay cotton cake and Egyptian cotton cake is not now so marked. Modern Egyptian cotton cake from a reliable source is greenish-brown in appearance, Bombay cotton cake being slightly more yellow, and on fracture the cake shows a slight fluffy appearance.

Composition and Feeding Value.—Bombay cotton cake, Egyptian cotton cake, and decorticated cotton cake, have been largely used for feeding fattening and mature stock, and, owing to their costive tendency are especially esteemed for use in the spring months when cattle are first turned out to grass. Owing to the occasional presence of a toxic substance (gossypol), the extensive use of cotton cake for mature stock is inadvisable, and it is also unwise to use it for pigs, young growing stock, and animals in young, since young stock appear to be more sensitive

to the toxic principle if present. When used in moderation, however, cotton cake is a valuable feeding stuff, *and the danger of the development of untoward symptoms is remote.* Excellent results will follow its use in practice if the following maximum quantities per head per day are not exceeded:—Milch cows and horses 2 lb., cattle 5 lb., sheep ½ lb.

British feeding trials, summaries of which have already appeared in previous issues of this *Journal*, have shown that cotton cake, whether decorticated or undecorticated, can be used successfully for feeding fattening sheep, cattle and milch cows.

Comparative Feeding Value of Bombay and Egyptian Cotton Cakes:—

Analyses.	Dry Matter.	Protein.	Fat.	Carb.	Fibre.	Dig. Prot.	Dig. Oil.	Dig. Carb.	Dig. Fibre.	N. Ratio.	S.E.
Bombay Cotton Cake... ...	87.7	20.2	4.8	35.2	21.7	15.6	4.5	18.9	4.4	1:2	40.0
Egyptian ...	87.9	23 0	5.5	32.4	21.2	17.6	5.1	17.5	4.5	1:2	41.8

From the two analyses shown, it will be seen that there is very little difference between the cakes from a feeding standpoint, and it is also evident that the extra fibre present in Bombay cotton cake can have but little influence on the digestibility of the cake. From the starch equivalent figures Egyptian cotton cake should be worth approximately 5 per cent. more than Bombay for feeding, *i.e.*, with Egyptian at £10 a ton Bombay is worth £9 10s. Owing to the prejudice against the Bombay cake the margin of price is generally greater than this, and farmers wishing to use cotton cake should carefully study the relative price of Bombay and Egyptian cake before deciding which to purchase. There is no special merit in Egyptian cotton cake that justifies a price difference of more than 5 per cent. on that of Bombay cotton cake.

* * * * * *

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·38	2 7	71·6	9 5	0 15	10 0
Oats	1·38	2 7	59·5	7 14	0 13	8 7
Barley	1·38	2 7	71·0	9 3	0 12	9 15
Potatoes	1·38	2 7	18·0	2 6	0 3	2 9
Swedes	1·38	2 7	7·0	0 18	0 2	1 0
Mangolds	1·38	2 7	6·0	0 16	0 3	0 19
Good Meadow Hay	1·83	3 5	31·0	5 6	0 13	5 19
Good Oat Straw	1·83	3 5	17·0	2 18	0 6	3 4
Good Clover Hay	1·83	3 5	32·0	5 9	1 0	6 9
Vetch and Oat Silage	1·61	3 0	14·0	2 2	0 7	2 9

	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	—	—	12/9	12 15	0 15	12 0	71·6	3/4	1·78
Barley, British Feeding	—	—	12/6	12 10	0 12	11 18	71	3/4	1·78
" Canadian :—									
No. 3 Western	44/6	400	12/6	12 10	0 12	11 18	71	3/4	1·78
" 4 "	43/6	"	12/2	12 3	0 12	11 11	71	3/3	1·74
" American	43/6	"	12/2	12 3	0 12	11 11	71	3/3	1·74
" Danubian	41/9	"	11/8	11 13	0 12	11 1	71	3/1	1·65
" Karachi	45/–	"	12/7	12 12	0 12	12 0	71	3/5	1·83
Oats, English, White	—	—	11/–	11 0	0 13	10 7	59·5	3/6	1·87
" " Black and Grey	—	—	10/6	10 10	0 13	9 17	59·5	3/4	1·78
" Scotch White	—	—	11/6	11 10	0 13	10 17	59·5	3/8	1·96
" Irish Black	—	—	10/10	10 17	0 13	10 4	59·5	3/5	1·83
" Canadian :—									
No. 2 Western	36/9	320	12/10	12 17	0 13	12 4	59·5	4/1	2·19
" 3 "	33/–	"	11/7	11 12	0 13	10 19	59·5	3/8	1·96
" Chilian	32/3	"	11/3	11 5†	0 13	10 12	59·5	3/7	1·92
Maize, Argentine	47/6	480	11/1	11 2	0 13	10 9	81	2/7	1·38
" South Russian	49/3	"	11/6	11 10†	0 13	10 17	81	2/8	1.43
Beans, English Winter	—	—	11/9	11 15	1 11	10 4	67	3/–	1·61
Peas, English Maple	—	—	12/11	12 18	1 7	11 11	69	3/4	1·78
" Japanese	—	—	26/3	26 5†	1 7	24 18	69	7/3	3·88
Rye, Homegrown	—	—	11/–	11 0	0 15	10 5	71·6	2/10	1·52
Tares	—	—	12/11	12 18	1 12	11 6	69·7	3/3	1·74
Dari, Egyptian	—	—	11/6	11 10	0 15	10 15	75·2	2/10	1·52
" Persian	—	—	12/–	12 0	0 15	11 5	75·2	3/–	1·61
Millers' Offals :—									
Bran, British	—	—	—	8 15	1 6	7 9	45	3/4	1·78
" Broad	—	—	—	10 0	1 6	8 14	45	3/10	2·05
Middlings—									
Fine Imported	—	—	—	11 12	1 1	10 11	72	2/11	1·56
Coarse, British	—	—	—	10 5	1 1	9 4	64	2/10	1·52
Pollards, Imported	—	—	—	9 7	1 6	8 1	60	2/8	1·43
Meal, Barley	—	—	—	13 10	0 12	12 18	71	3/8	1·96
" Maize	—	—	—	12 0	0 13	11 7	81	2/10	1·52
" " Germ	—	—	—	12 0	0 18	11 2	85·3	2/7	1·38
" " Gluten Feed	—	—	—	11 15	1 7	10 8	75·6	2/9	1·47
" Rice	—	—	12/–	12 0	1 2	—	71·4	—	—
" Locust Bean	—	—	—	10 0	0 9	9 11	71·4	2/8	1·43
" Bean	—	—	—	14 0	1 11	12 9	67	3/9	2·01
" Fish	—	—	—	20 0	4 4	15 16	53	6/–	3·21
Linseed	—	—	—	25 10	1 10	24 0	119	4/–	2·14
" Cake, English 12% Oil	—	—	—	15 2	1 17	13 5	74	3/7	1·92
" " 10% Oil	—	—	—	14 10	1 17	12 13	74	3/5	1·83
" " 9% Oil	—	—	—	14 7	1 17	12 10	74	3/5	1·83
Cottonseed Cake, English 5½% Oil	—	—	—	9 12	1 13	7 19	42	3/9	2·01
" " Egyptian 5½% Oil	—	—	—	9 5	1 13	7 12	42	3/7	1·92
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 7	2 13	10 14	71	3/–	1.61
Coconut Cake 6% Oil	—	—	—	12 10	1 10	11 0	73	3/–	1·61
Ground Nut Cake 7% Oil	—	—	—	—	1 15	—	57	—	—
Decorticated Ground Nut Cake 7% Oil	—	—	—	—	2 14	—	74	—	—
Palm Kernel Cake 6% Oil	—	—	—	10 5†	1 3	9 2	75	2/5	1·29
" " Meal 2% Oil	—	—	—	9 0*	1 3	7 17	71·3	2/2	1·16
Feeding Treacle	—	—	—	7 15	0 8	7 7	51	2/11	1·56
Brewers' Grains :—									
Dried Ale	—	—	—	9 12	1 4	8 8	49	3/5	1·83
" Porter	—	—	—	9 2	1 4	7 18	49	3/3	1·74
Wet Ale	—	—	—	1 10	0 9	1 1	15	1/5	0·76
" Porter	—	—	—	1 7	0 9	0 18	15	1/2	0·62
Malt Culms	—	—	—	8 10†	1 13	6 13	43	3/1	1·65

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have tak[en] place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end [of] October and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriag[e] and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their loc[al] market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per to[n]. Its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, th[e] starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing th[is] again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A simil[ar]

Short Course in Clean Milk Production.

A COURSE of instruction in the production and handling of milk will be held at University College, Reading, from Wednesday, 28th January, to Saturday, 21st February, 1925. The course is intended primarily for dairy instructors and instructresses, but other students will be admitted if the accommodation will allow.

Application for admission to the course should be made in the first instance to the Dean, Faculty of Agriculture and Horticulture, University College, Reading, and intending students should be prepared to commence work at 9 a.m. on Wednesday, 28th January. The fee for tuition for the three weeks will be £5, which must be paid to the College Office.

Instruction will take the form of lectures combined with demonstrations and laboratory work, and will deal with such matters as milk supply and production, legislation and regulations regarding milk, applied bacteriology of milk and the chemical compositon of milk. Excursions will be arranged to well-known dairy farms, factories and depots, but the travelling expenses in connection with these are not included in the tuition fee.

The College cannot undertake to arrange residence for students but will give all possible assistance and advice. Students are advised to take bicycles.

* * * * * *

Manuring for Meat.

FOLLOWING the inception of the campaign by the Ministry for the improvement of grass land, the Nottinghamshire County Council on 6th April, 1920, leased "Happy Land," comprising about 77½ acres of poor pasture typical of large areas of land under grass in the county, on the East Stoke Estate, near Newark, for a period of seven years, at a rent of 10s. per acre, to enable the Agricultural Education Sub-Committee of the Education Committee to carry on a large scale demonstration of the improvement of grass land.

Since 1900 the land had been grazed during the summer, and to a less extent during winter, chiefly by sheep, and there is no record of the application of farmyard manure or fertilisers or of the feeding of cake or corn to stock on the land. The soil is a strong retentive clay subject to serious flooding. The hedges had not been plashed for 25 years, and were all high and much overgrown, and the cross fences had been broken down, so that the whole area was grazed as one field.

The valuer's estimate of the pastures in April, 1920, was as follows:—

Field.	*Total Area.*	*Sheep per acre, average.*	*Letting value per acre per annum.*
	Acres.		s. d.
A	$18\frac{1}{2}$	$3\frac{1}{2}$	11 6
B	$19\frac{1}{2}$	4	12 0
C	$21\frac{1}{2}$	$2\frac{1}{2}$	9 0
D	18	2*	7 0

* At intervals during the grazing season.

Chemical analysis proved that the clay soil on "Happy Land" was deficient in nitrogen, phosphates and lime, and a botanical survey indicated the general occurrence of wild white clover, but in a very "starved" condition. Seedling thorn bushes were present on Field C, and were numerous on Field D.

After careful consideration it was decided to divide the land, using existing fences, into four fields for the purpose of the demonstration, as follows:—A, $18\frac{1}{2}$ acres; B, $19\frac{1}{2}$ acres; C, $21\frac{1}{2}$ acres; and D, 18 acres.

A paddock of 3 acres has since been fenced off from the northern end of C and $1\frac{1}{2}$ acres from the western end of B, for experimental plots; all the experimental fields are thus 18-$18\frac{1}{2}$ acres in area.

It was decided to adopt the following manurial scheme, and the fertilisers were applied on 5th November, 1920.

Field	Acreage	Fertilisers: Description	Fineness	Phosphates: Total	Phosphates: Citric Sol.	Lime (CaO)	Quantity per acre	Phosphoric Acid per acre	Cost per acre, 1920
			Per cent.	Per cent.	Per cent.		cwt.	lb.	£ s. d.
A	$18\frac{1}{2}$	Nil	—	—	—	—	—	—	—
B	18	Basic Slag 38% ...	—	39·58	32·90	1·80	$7\frac{3}{5}$	150	2 13 8
C	$18\frac{1}{2}$	Mineral Phosphates 60%	72	57·16	20·77	—	$7\frac{1}{2}$	225	3 3 9
D	18	Basic Slag 20% ...	—	20·35	6·42	4·35	$13\frac{3}{5}$	150	3 12 9

The fields have been grazed each year by cattle and sheep and their live weight increases recorded.

The following table sets out the first and last weighings and live weight increases for the whole period of the experiment

as far as it has gone. It will be seen that whereas Field A has practically stood still, the manured areas have increased their returns to a remakable degree.

Live Weight Increase Per Acre 1920*–1924.

Field	Year	1st Weight	Final Weight	Live Weight Increase	
				Total	Per acre
		T. C. Q. lb.	T. C. Q. lb.	T. C. Q. lb.	Q. lb.
A	1920*	3 5 2 9	4 1 3 20	16 1 11	3 15
	1921	3 2 2 0	4 12 1 0	10 2 21	2 8¾
	1922	4 4 0 9	4 11 1 2	16 1 22	3 15½
	1923	4 0 0 14	5 8 1 21	1 8 1 7	6 3
	1924	3 3 0 9	4 1 0 8	17 3 27	3 25
B	1920*	2 17 3 1	3 13 0 11	15 1 10	3 11½
	1921	3 17 2 21	5 17 2 21	13 2 0	3 0
	1922	4 13 1 23	7 16 1 13	1 5 1 24	5 18½
	1923	6 4 0 21	9 3 0 14	2 11 0 19	11 10¼
	1924	6 10 1 0	8 12 3 0	2 2 2 0	9 12½
C	1920*	1 15 0 21	2 6 1 17	11 0 24	2 12
	1921	1 18 2 0	3 2 3 14	9 1 7	2 0¼
	1922	3 16 3 13	4 14 0 6	17 0 6	3 19¼
	1923	4 2 0 23	6 5 3 14	2 8 3 10	10 15½
	1924	5 17 0 21	7 3 2 12	1 6 1 19	5 20
D	1920*	1 2 3 26	1 9 1 7	6 1 9	1 11½
	1921	1 5 2 21	2 16 2 14	6 0 21	1 10½
	1922	3 8 2 4	2 11 3 13	11 3 13	2 17¾
	1923	2 15 2 4	3 18 0 21	1 5 1 14	5 18
	1924	2 19 0 2	3 18 3 2	19 3 0	4 11

* All fields unmanured in 1920 (which was thus a control year).

The live weight increase obtained in 1921, owing to the drought, was less than in the previous season, and a study of the figures for that year, as given in the above table, shows that the manured areas held out considerably longer than the unmanured area (Field A).

The increased stock-carrying capacity of the pastures receiving manurial treatment should be noted.

The effect of the fertilisers applied can be expressed in the additional live weight increases per acre in 1923 and 1924, when compared with 1920.

These are as follows:—

	1923.		*1924.*
Field A (control)	2 qr. 16 lb.	...	10 lb.
Field B ...	7 " 26¾ "	...	6 qr. 1 "
Field C ...	8 " 3½ "	...	3 " 8 "
Field D ...	4 " 6½ "	...	2 " 27½ "

The year 1923 was more normal than 1924 from a grazing point of view, and the results are much more striking.

Regulation of Commons.

THE Ministry has recently issued revised regulations under the Commons Act, 1899. Copies may be obtained through any bookseller or direct from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2 (Statutory Rules and Orders, 1924, No. 1157, dated 4th October, 1924), price 2d. net.

The Act provides a convenient method of regulating commons, including town and village greens. District and County Borough Councils are empowered to frame schemes which become operative if approved by the Ministry, and the new regulations include a revised model scheme. No interest or right of a profitable or beneficial nature in or over a common may be interfered with by a scheme without compensation. Three months' notice must be given by a Council of their intention to make a scheme. During that period copies of the draft scheme may be obtained, the plan inspected, and objections or suggestions in writing made to the Ministry by any person. After the expiration of the three months and due consideration of any objections or suggestions so made, the Ministry may by order approve the scheme subject to such modifications, if any, as they think fit. The Ministry may not, however, confirm the scheme if either *(a)* the person entitled as lord of the manor or otherwise to the soil of the common, or *(b)* persons representing at least one-third in value of such interests in the common as are affected, give written notice of their dissent from the scheme.

The management of any common regulated under the Act is vested in the Council making the scheme, who may, however, delegate their powers to Parish Councils in certain cases.

* * * * * *

National Poultry Institute: Appointment of Director.

THE Governors of the Harper Adams Agricultural College have offered the position of Director of the National Poultry Institute, which is to be established at the College, to Professor Willard C. Thompson, Head of the Poultry Division of the New Jersey State Agricultural Experiment Station, U.S.A. Professor Thompson, whilst unable to accept a permanent appointment, has agreed to act as Director for a period of two years, and his appointment subject to this proviso and to the approval of the Ministry of Agriculture has been confirmed by the Governors. It is expected that Professor

Thompson will be able to take up his duties at the College about the middle of November.

In making this appointment the Governors have been actuated by the conviction of the imperative necessity for obtaining the very best man available for this important new development, which demands a combination of sound scientific training, experience in teaching and research, and wide practical experience, and they are satisfied after careful and prolonged enquiry, that this aim could not be secured without going outside the confines of this country. Professor Thompson has won a high reputation on the American continent through his work at the New Jersey Station, and has the advantage of personal acquaintance with many of the leading representatives of the poultry industry in this country, whose unanimously favourable testimony to his ability and personality has greatly influenced the Governors in making the appointment.

* * * * * *

A County Council Wool Exhibition.

THE importance of sheep rearing in the farming of Brecon and Radnorshire prompted the Agricultural Education Committee of the two counties to stage a wool exhibition at the Llandrindod, Knighton, Devynock and Brecon agricultural shows this year.

The object in view was to disseminate information regarding the wool industry of the country, and also to emphasise the importance of putting up wool for marketing to the best advantage. The exhibit was staged with the co-operation of Mr. Hugh M. Lloyd, a member of the County Council, the exhibit being arranged on behalf of the Committee by his firm, Messrs. Mark Lloyd & Sons. The exhibits filled a marquee of about 45 ft. by 30 ft. in size, and consisted of representative fleeces of wool of the following breeds of sheep :—South Down, Oxford Down, Suffolk, Cheviot, Romney Marsh, Lincoln, Wensleydale, Devon, Irish Hogs, Scotch, and the local breeds, to which special prominence was given, viz., Shropshire, Kerry Hill, Ryeland, Radnor, and Welsh, also turbary and discoloured Welsh fleeces.

To illustrate the carelessness of some farmers in the manipulation of their wool, fleeces were shown with daggings, stuffed with pelled and tail wool, and also fleeces damaged by raddle. The object of including these was to emphasise the fact that such wool could not possibly realise the price paid for clean fleeces.

Other commodities staged were mohair as grown on the Angora goat from Turkey, the same after being scoured, the tops, and the finished woven material; Lincoln and Welsh tops; fleeces of greasy Puntas Arenas from South America; greasy cross-bred New Zealand wool as imported, also the same after scouring, the noils and tops; scoured merino (Cape); greasy merino (Australian), and scoured wool, noils and tops. Yarns spun from British and Colonial wools were shown, with representative cloths from each; also carpet yarn from wool and hair, and dyed rug wool showing a full range of colours.

A series of large photographs was displayed showing the whole process of manufacturing wool into cloth, *e.g.*, scouring, combing, spinning, weaving. Also a valuable chart lent by the Bradford Technical College describing the English method of worsted yarn manufacture.

A leaflet containing " Suggestions on how to get up Wool " was distributed to farmers, and it is estimated that well over 5,000 people passed through the tent at the four shows.

* * * * * *

Germination of Seed Peas.

THE Regulations made under the Seeds Act, 1920, require, in the case of a sale of seed peas, that the seller shall deliver to the purchaser a statement in writing containing certain specified particulars including (1) the name and address of the seller: (2) a statement that the seeds have been tested in accordance with the provisions of the Act; (3) the kind of seed; (4) the percentage of purity if below 97 per cent.; and (5) the percentage of germination; provided that if the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the Schedule to the Regulations (viz., 70 per cent.) a statement to that effect, which shall include the authorised minimum percentage of germination, shall be sufficient.

Owing to the bad harvest conditions, there are indications that the germination of English and other European-grown seed peas of the 1924 crop is below that of a normal season. Consequently, a considerable proportion of the seed peas of the new crop which will be marketed this season will probably be found to germinate slightly less than the minimum percentage of germination prescribed in the Seeds Regulations. It should be observed, however, that the Seeds Regulations do not prevent the sale of seed peas with a germination of less than 70 per

cent., but in such cases it is essential that the actual percentage of germination should be declared. To avoid failures in the crop, it is desirable that seeds testing less than 70 per cent. should be sown rather more thickly than usual.

* * * * * *

Export of Potatoes to France and Algeria.

IN June last a Decree was promulgated by the French Government under which potatoes to be exported from Great Britain and Ireland to France or Algeria were required to be accompanied by a certificate to the effect that they had been grown at a place not less than 20 kilometres away from any land on which wart disease had occurred. The serious effect of this Decree on the important seed potato growing districts in South Lincolnshire and elsewhere was immediately realised by the Ministry, and representations were forthwith made to the French Department of Agriculture that this radius was unnecessarily wide in view of the measures taken to control the disease in this country.

The Ministry is happy to announce that the French Authorities have now agreed to reduce the radius to 5 kilometres. Inspection of the potatoes by officers of the Ministry before export is still required.

* * * * * *

Seed Control in Esthonia.—For the purpose of carrying out the Regulations governing the sale of seeds in Esthonia, all firms and persons dealing in seeds are required to register themselves with the Esthonian Ministry of Agriculture. Firms and persons not having registered have no right to carry on a trade in seeds. In the case of a sale of agricultural and garden seeds, the seller is required to issue, on the request of the purchaser, a certificate containing certain specified particulars as to the percentage germination, purity, etc. The purchaser may within 15 days of delivery of the seed draw a sample for check testing at the Official Seed Testing Station, and if the result of this test shows that the seed is of an inferior quality, the seller is obliged to return to the purchaser the corresponding portion of the amount paid.

The Official Seed Testing Station is prepared to undertake the permanent supervision and control of the seeds of any particular firm, and, if desired, will seal the bags containing the seed in order to preserve the guaranteed seeds intact.

The sale of seeds containing 4 per cent. of weeds is prohibited, and in the case of certain specified weeds the prohibitive content is as low as 1 per cent. The importation and sale in the interior of the country of clover, timothy and other seeds containing dodder, is also prohibited.

The importation into Esthonia of red clover, alsike, white clover, timothy, lucerne and birdsfoot trefoil is permitted subject to the

approval of the Ministry of Agriculture. Samples of the seeds are taken by the Customs and are subjected to a test by the Official Seed Testing Station. If the analysis of the seeds shows that they are unsuitable for sowing or that they contain more than the specified proportion of weed seeds, their importation is prohibited, and they must either be re-shipped under Customs supervision, or destroyed in conformity with the Customs Regulations, whichever the importer may elect.

International Congress on Technical Education Agriculture). — An International Congress on Technical Education will be held at the Université du Travail, Charleroi, Belgium, in April, 1925, one section of which will deal with technical agricultural instruction. The Congress will give an opportunity to all interested in agricultural education to become acquainted with the agricultural institutions of the Province of Hainault, their up-to-date organisation, and the combination of scientific, practical and professional instruction which is achieved. With this object, visits will be organised to agricultural institutions, where demonstrations will be given, and a series of papers will be contributed to the Congress by members of the staffs and by agriculturists who have passed through the various institutions.

The Congress also invites the collaboration of Belgians and others, by the contribution of papers, accompanied by resolutions, or by participation in the meetings of the Congress. Inquiries or entries should be addressed to Monsieur R. Duquesne, Secretary of the Executive Committee of the Congress, 46 Rue de Hautbois, Mons, Belgium, No subscription is required.

Foot-and-Mouth Disease. — At the end of October and the beginning of November the position as regards foot-and-mouth disease in Great Britain became distinctly threatening, and there was for some time reason to apprehend a very widespread outbreak of the disease in the Midlands. On 25th October outbreaks occurred in Leicestershire and Derbyshire in areas already subject to restrictions and arising out of the infection at Derby and Lichfield Markets. Further outbreaks took place during October as follows:—On 25th, at Alfreton; 27th, at Matlock; 28th, at Derby; 29th, at Rugeley, Staffordshire; 31st, three outbreaks in Derbyshire. two near Derby and one at Alfreton; also during November: on 1st, two cases in Staffordshire; 3rd, one case in Staffordshire and one in Derbyshire; 4th, two cases in Staffordshire in the Rugeley district; and 5th, two cases in Staffordshire, near Lichfield and Walsall, and one near Tamworth, Warwickshire. Since 5th November, however, there have been three further cases of disease in this area, and it is now hoped that the spread of disease from Derby and Lichfield Markets has been arrested. In view of the danger which, for the time being, existed, a very large area in the Midlands had to be placed under restrictions.

On 31st October, an outbreak occurred at Thorpe-le-Soken, Essex, in a district previously free from outbreaks; on 1st November three new centres of disease were discovered at Peterborough; Haslington, near Crewe; and Cold Hiendley, near Barnsley, Yorkshire; and on 20th November a new centre appeared at Chatham. Kent. The case near Crewe was connected with the infection at Derby Market of 17th October but there is no information available as to the origin of the other cases.

Leaflets issude by the Ministry. — Since the date of the list given on page 693 of the October issue of the *Journal*, the following leaflets have been issued:—

New:—

No. 64. The British Warblers.
" 74. Cultivation of Turnips, Swedes and Kohl-Rabi.
" 79. Home Grown Wheat for Bread Making: The value of Improved Varieties.
" 305. The Growing of Field Peas for Stock Feeding.

Re-written:—

No. 395. Adult Bee Diseases.

Revised:—

No. 26. Farmers and the Income Tax.
" 56. Apple Canker.
" 145. Sheep Dipping.
" 207. Strawberry Cultivation.
" 251. Some Common Weeds.
" 306. The Goat as a Source of Milk.

Amended:—

No. 197. Agricultural Education in England and Wales.

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NOTICES OF BOOKS.

Commercial Cucumber Culture.—(By the Lea Valley Correspondent to the *Fruit Grower.*) This useful little handbook written by a practical man should prove very helpful to all interested in the glasshouse cultivation of cucumbers. As the author states in his introduction, the growing of cucumbers is no longer merely that of a "catch crop," but has become the principal concern of many big establishments worked on lines similar to factories. It therefore behoves those who intend competing in this department of horticulture to know the most up-to-date methods; and the methods adopted in the Lea Valley form an excellent guide.

The book deals concisely with all the chief points in the routine of cucumber cultivation, and is neatly arranged and well set out. It makes frequent references to the work of the Cheshunt Experimental and Research Station: the author evidently believes in the value of research, and rightly holds that others should realise its advantages. A little more might have been said about "Varieties," and the chapter on "Top Dressing and Mulching" might have been included before those on "Pests and Diseases" to preserve the consecutiveness of the book. Too many printer's errors occur, and will need to be remedied in subsequent editions.

The final chapter on "Management and Organisation" is an excellent addition, and the hints and advice given therein are worthy of study by all employers who wish to make a success of their business and who have the welfare of their employees at heart.

Journal of the Royal Agricultural Society of England.—(Vol. 84. 1923.) A number of interesting and useful special articles on various aspects of scientific farming by well known authorities provide the subject matter for the first portion of the latest volume of the *Journal of the Royal Agricultural Society of England.* Among these the "Laying Down of Land to Grass," by Professor W. Somerville, and "Beef Production," by Professor T. B. Wood, are typical.

A certain amount of research work was conducted by the Society in 1923. An article on "Experiments with Cereals in Norfolk," by C. Heigham, describes experiments in the growing and testing of new varieties, conducted on behalf of the Research Committee of the Society by the Norfolk Agricultural Station, as well as a plan for the growing on of the pure seed of varieties already approved.

The results of experiments designed to test the relative merits for pig-feeding of various rations composed exclusively of home-produced foods are discussed in an article by Dr. C. Crowther, M.A., and W. S. Chambers, B.Sc. (Agr.), B.Com.

The Journal also contains comprehensive reports of the Society's annual show, held in 1923, at Newcastle. It is interesting to note that the show resulted in a record profit of £19,100 11s. 2d., largely due, no doubt, to the good weather experienced.

A number of other interesting articles, reports, notes and reviews complete the volume.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Orwin, C. S.—Farm Accounts. 2nd edn. rev. (140 pp.) Cambridge: University Press, 1924, 5s. [657(02).]

Honcamp, F., and *Nolte, O.*—Agrikulturchemie. (165 pp.) Dresden and Leipzig: Theodor Steinkopff, 1924. [54(02).]

Departmental Committee on Agricultural Education and Research in Scotland.—Report of the Departmental Committee, appointed in February, 1924, to consider and advise regarding the General Organisation and Finance of Agricultural Education and Research in Scotland. (54 pp.) London: H.M. Stationery Office, 1924, 1s. [37(41).]

Bentham, G., and *Hooker, Sir J. D.*—Handbook of the British Flora: a Description of the Flowering Plants and Ferns indigenous to or Naturalised in the British Isles. For Beginners and Amateurs. Seventh Edition, revised by *A. B. Rendle.* (lxi + 606 pp.) London: L. Reeve & Co., 1924, 12s. [58.19(42).]

Lathouwers, V.—Manuel de l'Amélioration des Plantes de la Grande Culture: Méthodes, Bases Scientifiques, Technique. (240 pp.) Gembloux: Jules Duculot, 1924. [63.1952.]

Loeb, J.—Regeneration from a Physico-Chemical Viewpoint. (151 pp.) New York and London: McGraw-Hill Publishing Co., 1924, 10s. [58.11.]

Field Crops.

Hunter, H.—Oats: Their Varieties and Characteristics. A Practical Handbook for Farmers, Seedsmen and Students. (131 pp.) London: Ernest Benn, Ltd., 1924, 8s. 6d. [63.314.]

Erith, A. G.—White Clover (*Trifolium repens*, L.): A Monograph. (160 pp.) London: Duckworth & Co., 1924, 18s. [63.33(b).]

U.S. Department of Agriculture.—Dept. Bull. 1248:—Size of Potato Sets: Comparisons of Whole and Cut Seed. (43 pp.) Washington, 1924. [63.512.]

Horticulture and Fruit Growing.

Sanders, T. W. and *Lansdell, J.*—Grapes, Peaches, Melons, and How to Grow Them. A Handbook dealing with their History, Culture, Management and Propagation. (144 pp. + 10 pl.) London: Collingridge, 1924, 5s. [63.46(02); 63.41(b); 63.511.]

Oregon Agricultural Experiment Station.—Bull. 208:—Filberts. Part I. Growing Filberts in Oregon. Part II. Experimental data on Filbert Pollination. (30 pp.) Corvallis, 1924. [63.41(d).]

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NOTES FOR THE MONTH.

A MEETING of the Agricultural Wages Board was held on 18th December at 1, Whitehall Gardens, S.W.1, the Chairman, Lord Kenyon, presiding.

Agricultural Wages Board: Minimum Wages.

The Board considered notifications from the Agricultural Wages Committees for Berkshire, Essex, Norfolk, and Anglesey and Carnarvon, of their resolutions fixing minimum rates of wages, and proceeded to make the necessary Orders carrying out the Committee's decisions and specifying the dates from which the rates shall become effective, the date specified being in each case 29th December.

The minimum rates thus fixed and made effective are the first to be brought into force under the Agricultural Wages (Regulation) Act, 1924. In the case of adult male workers the rates are as follows:—

Berkshire.—29s. 2d. for a week of 50 hrs.; the Order to run to 30th September, 1925.

Essex.—30s. for a week of 48 hrs. to 8th February, 1925, and of 50 hrs. from then until the expiration of the Order, which will be three months from the date of coming into operation.

Norfolk.—28s. for a week of 48 hrs. to the first Monday in March, 1925, and from then 29s. until the expiration of the Order on the 10th October, 1925, with additional weekly sums of 5s. 6d. for workers employed as teamsmen, cowmen or shepherds, and of 4s. 6d. for those employed as sheep-tenders or bullock-tenders.

Anglesey and Carnarvon.—35s. for a week of 58 hrs. in the case of workers employed wholly or mainly as horsemen, cowmen, shepherds or hwsmyn (bailiffs), and 30s. for 50 hrs. in the case of other adult male workers. The Order to run to 13th May, 1925.

The Orders in question include minimum rates for male workers under 21 and also, except in the case of Anglesey and Carnarvon, for female workers. Copies of the Orders in full can be obtained on application to the Ministry.

(58651) P.6./R.4. 8,250. 1/25 M. & S.

A number of other Committees have arrived at preliminary decisions with regard to minimum rates, and a list of these is given on p. 972 of this issue of the *Journal*.

* * * * * *

Rural Industries.

THE Ministry is anxious to encourage the development and maintenance of rural industries by all the means in its power. By rural industries are chiefly meant those additional and subsidiary home employments of the countryside which serve to augment the income of rural workers: in some favourable cases, of course, they provide the whole of the income. In a few counties a Rural Industries Sub-Committee of the County Council is in active existence, and the Ministry desires to see these Sub-Committees operating in every county, and to help in achieving that object a circular has recently been addressed to all County Councils, indicating that financial assistance will, if required, be made available.

The general business of the development of rural industries is also the special care of the Rural Industries Bureau, 258/262, Westminster Bridge Road, S.E.1, which is prepared to give practical advice on starting or restarting local industries and on securing markets for the goods produced. Clearly this last is an essential need; the goods produced, whether woodwork, metal work, rush work, matting, lace or what not, must be systematically marketed if the industries are to become properly established. The goods may be a little dearer than ordinary shop goods, but are usually better made, more lasting and more beautiful than factory-made articles.

A Conference of representatives of shops and depôts, craftsmen and industries, women's institutes and the Country Industries Limited, London, was held at the end of November at the offices of the Development Commission, a department which is closely associated with the movement. The Conference was a real success. A Resolution was passed to the effect that a small committee should be set up to discuss the formation of an Association of those engaged in rural industries so that the production and sale of work by competent rural craftsmen might be developed.

The Ministry considers that it is to the benefit of all farmers and others dwelling in the country, and of the nation at large, that rural industries should be widely established, and it calls upon everyone interested to take whatever steps are possible to further the movement.

County Clean Milk Competitions.

IN the early months of 1924 great strides were made in the Clean Milk Competition movement. In addition to competitions again held in Essex, Bucks and Kent, county schemes were initiated in Leicester, Yorkshire, Surrey, Northern Counties (Northumberland, Durham, Cumberland, and Westmorland), Derbyshire and Berkshire. In the last-named county the competition was novel, inasmuch as it was limited to herdsmen, whilst in all other cases the entrants were employers or small farmers.

Local Education Authorities were concerned in the organisation of all these competitions, and in Essex, Kent and Yorkshire they had the co-operation of the County Milk Recording Societies; the Northern Counties Competition was organised by the Armstrong College with the co-operation of the Local Education Authorities concerned. The periods over which the competitions were held ranged from three to five months and the average number of competitors was 26.

Except in the case of the Derbyshire competition, the relative efficiency of competitors was recorded in the form of marks based on conditions on the farm as judged by inspection, and examination of the milk produced. In Derbyshire no marks were given for inspection on the farm. In all cases samples were forwarded to the examining laboratory (generally the Provincial Agricultural Institution) at regular intervals, and in addition at least one "surprise" sample was taken by the Inspecting Judge on the occasion of his visit.

Prizes (challenge cups, medals, etc.) were awarded to owners of winning herds, and money prizes were given to their respective employees engaged in milking. In addition certificates were given to owners and herdsmen where a specified percentage of marks was obtained. In most cases local manufacturers contributed towards the prize funds, and in many cases the National Milk Publicity Council provided cups, medals and certificates.

The results of these competitions fully demonstrated that the production of clean milk is not primarily a question of buildings, but of intelligent interest and care on the part of the owner of the herd and his employees. Whilst it is agreed that modern buildings certainly make the work much easier, it has been found that provided there is ample light, good ventilation and sound flooring, the buildings take but a secondary place.

A notable point in the laboratory reports is the considerable number of competitors who succeeded in producing milk above

the standard of cleanliness required for the production of designated milk. Many of these competitors have now obtained licences to produce such milk, and others are considering doing so.

That the competitions have been of distinct educational service is demonstrated by the large number of competitors who have been awarded diplomas and certificates for obtaining over two-thirds of the total possible marks. In the majority of cases this standard can only be attained if the competitor follows the advice given to him by the Inspecting Judge and members of the County Staff. The number of competitors awarded diplomas and certificates is shown in the following comparative statement:—

Competition	*No. of Competitors*	*No. of Competitors awarded Certificates, or who obtained over ⅔rds of total possible marks*
Kent	46 ...	36
Essex	21 ...	11
Leicester	21 ...	12
Berkshire	7 ...	5
Yorkshire	18 ...	6
Bucks.	19 ...	10
Surrey	49 ...	21
Northern Counties	40 ...	11
Derby	11 ...	6

Competitions should also have been held in Northants and Staffordshire early in 1924, but owing to the prevalence of foot-and-mouth disease they were postponed until favourable conditions prevail.

Other counties which have competitions in progress or just completed are Dorset, the Midland Counties (Derby, Leicester, Lindsey, Notts and Rutland), Somerset and Middlesex. In Dorset one competition is being held from July, 1924, to July, 1925; it is organised by the Local Education Authority in co-operation with the Melplash Agricultural Society, and is open to farmers in West Dorset; there are 9 competitors. Another Dorset competition, organised by the Local Education Authority in co-operation with the Somerset and North Dorset Milk Recording Society was held from September to December, 1924; this was open to farmers in North Dorset. It is hoped at a later stage to organise competitions in East and South Dorset. The Midland Counties Competition, organised by the Midland Agricultural College in conjunction with the respective Local Education Authorities, commences in January, 1925. This is an Inter-County Competition, and in addition to the main prizes, each

county will have a prize fund for its own competitors. Each county is holding a preliminary three months' competition, from which the winning competitors will be chosen for the main competition. The Somerset Competition is being held from November, 1924, to February, 1925, and is organised by the Local Education Authority with the co-operation of the local Milk Recording Society.

It will thus be observed that some 20 Local Education Authorities have become actively interested in clean milk competitions, and there is every probability that these Authorities will again organise competitions in 1925. In addition, arrangements have been made to hold competitions early in 1925 in Cornwall, Cheshire, Hertfordshire, Gloucester, East and West Sussex, Hampshire, Wiltshire and Worcestershire, and it is quite likely that Cambridgeshire and East and West Suffolk will also participate in the scheme.

In the future organisation of clean milk competitions, the Guide recently issued by the Ministry* should be of the greatest help in securing a uniform and reliable basis on which to work. It is hoped that the procedure outlined in the Guide will be followed in all cases, and that copies of the Guide will find their way into the hands of all competitors, who will thus secure a clear idea not only of the scheme in which they are taking part, but of the main principles involved in the production of clean milk.

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Ancient Roman Agriculture.

THE following account of a lecture on Columella delivered by Professor W. A. Osborne, of the University of Melbourne, before the Classical Association of Victoria, on 29th July last, is taken from the September number of *Iris*, the Association's news sheet.

Columella's work is the most comprehensive treatise on agriculture that antiquity has given us. We know little of his life, except that he was born in Spain, and was a contemporary of Seneca. His thirteen books embrace the most elaborate details of everything connected with farming. As the first essentials for success he lays down three qualities—knowledge, capital, and love of the work. The farm should have a healthy and fertile site, good roads, good water, and a good neighbour. In the homestead beauty as well as utility should be studied,

* Miscellaneous Publication No. 43, direct from the Ministry, 10, Whitehall Place, S.W.1, price 6d., post free.

for the sake of the wife, and it should not be placed too near the marshes, " because of the stinging insects "—not that Columella connected mosquitoes with malaria, though Varro had made a kind of guess at the connection. On the duties of the overseer and the management of the slaves he is very human and practical; the overseer should be middle-aged and married, and should be kept sweet by an invitation to dinner now and then; the ploughman should be big and should have a big voice. After such general directions for management, he goes on to details about varieties of soil, implements, different kinds of wheat and cereals, viticulture, cattle and domestic animals, poultry, fish and bees. The Roman ate far less meat even than an Englishman, to say nothing of an Australian, and got his protein chiefly from poultry, fish and game, though pork was much eaten. They were at their best on poultry, and in pisciculture they were far ahead of us; they had not the disadvantages of railway trains and freezing chambers; but kept their own fish-ponds, both salt and fresh. In apiculture, as we know from Virgil, the Romans were very skilled.

Columella treats also of flower gardens and kitchen gardens, of medicinal herbs, and of trees. The Roman grew the plum and damson, the peach, the cherry, the fig, pomegranate, vine, apple and other fruits. This acclimatisation of new fruits is one of the greatest services of the Roman Empire; wherever they found a new fruit or vegetable on the outposts of their dominions, they cultivated it; there was no such accession of new foodstuffs till the discovery of America. But they had not the lemon, which came with Islam, nor the orange, which was not in Europe till 1547, nor the date, which will not usually grow on the north shore of the Mediterranean.

Columella has left a work of real importance on agriculture, but he has left what is perhaps more valuable, a vivid picture of country life in the early Empire, and a reminder that all life in Italy was not like the life in the capital depicted by satirists and historians, nor like the life in the provincial towns pictured in the " pro Cluentio."

Dr. A. E. V. Richardson, Agricultural Superintendent of the State of Victoria, spoke of the high development of agriculture in Roman times, and showed that Australians have special reasons for being interested in it. Pliny mentions a " header " used in Gaul; it was pushed forward by the horse, and nipped off the heads of corn by a mechanical cutter; but this fell out of use and knowledge, until invented again in

South Australia in the same crude form, and afterwards developed into the present complex machine. Further, he told of a tradition that it was Columella's uncle who brought to Columella's Italian farm some Spanish rams from the Pyrenees, and these rams, crossing with the Italian sheep, were the direct creators of the great Australian merino.

Note.—As a commentary on Dr. Richardson's remarks on Pliny's "header" or stripper, an extract from his article on wheat growing in the August number of the Journal of the Department of Agriculture of Victoria (p. 468) is interesting :—"Ridley, of South Australia, produced in 1845 the first successful stripper. He employed the principle of the Gallic machine and removed the heads from the standing crop by means of a comb and rapidly revolving beater."

The idea of putting the machine before the motive power, which was a feature of Pliny's machine, was repeated in England by Pitt (1787) and by Boyce (1799), and in France by Person. Boyce, it is stated, was the first in England, perhaps the first in the world, to patent a reaping machine. It was unfortunately not a success. Other designs will be found in the literature cited below. Ridley's (1845) machine, in its earlier stages, is described in a letter from Captain Grey, Governor of South Australia, dated December, 1843, which is printed on p. 284 of Vol. V (1844) of the R.A.S.E. Journal. Those who wish to pursue the subject might consult :—(1) Pliny, Hist. Nat., XVIII 30 (72) 296; (2) Palladius, Re Rust., VII 2; (3) Petrus de Crescentiis, III 7; (4) Capel Loft in Annals of Agriculture, Vol. IV (1785), p. 205; (5) Pitt (on his design), *ibid.*, Vol. VIII (1787), p. 161; (6) B. Woodcroft, Appendix to the specifications of English patents for reaping machines, 1853; (7) Official Retrospective Exhibition of Harvesting Machinery made for the Paris Exposition of 1900 by the Deering Harvester Co.; (8) G. Kühne, Die Erntemaschinen, No. 117 of the Arbeiten der Deutschen Landw. Gesellschaft, 1910; (9) Nachtweh, Reconstruction of ancient Gallic Mowing Machines, Journal für Landwirtschaft, 1911, p. 1, and p. 367; (10) Journal of the Ministry of Agriculture, Vols. XXIX, p. 1089 and XXX, p. 42. A Trial of Mowing Machines, and Vol. XXX, pp. 121 and 223, A Trial of Harvesting Machinery; (11) Nachtweh in Die Landmaschine, No. 3 (27th Sept.), 1924, p. 596. (12) Lefebre de Noëttes, La force motrice agricole chez les anciens et la moissoneuse gauloise décrite par Pline, C.R. Acad. Agric. de France No. 32, 1924, p. 924. (13) A. Dickson, Husbandry of the Ancients, Vol. II, pp. 362 foll.

Of the above (3) is in the Rothamsted and R.A.S.E. libraries, and (6) and (7) in the Patent Office library. Most of the other references can be consulted in the Ministry's library.

Of the first three authors cited, Palladius (4th century) differs from Pliny (1st century). Petrus de Crescentiis (13th-14th) century) copies practically verbatim from Palladius, and gives no indication that the machine was in use in his time. A 16th century Italian poet, Alamanni (Coltivazione, II, 194), gives a brief description of a machine which does not seem to be copied from his predecessors, but his account of the conditions under which it was used is practically the same as given by Palladius.

* * * * * *

The Agricultural Index Number.

THERE was a further slight increase in the index number of prices of agricultural produce during November, and the general level of prices for that month stood at 64 per cent. above the corresponding month in the years 1911 to 1913, 11 points higher than in November, 1923, and 2 points higher than two years before. Since July, when the price level reached its lowest point of the year, there has been a rise of no less than 12 points.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	59
September	202	116	57	56	60
October ...	194	86	59	51	63
November	193	79	62	53	64
December	184	76	59	56	—

In pre-war days, most kinds of agricultural produce were inclined to advance in price between October and November, and the rise of one point recorded this year reflects a rise in the price level, not only actually, but also relatively to pre-war.

As regards individual commodities, no very striking changes are recorded on the month. The most important alterations among commodities sold off farms are the fall of 14 points for

barley and the further rise of 14 points for potatoes, which at an average of £9 10s. per ton were realising in November no less than 168 per cent. more than in the corresponding month before the war.

Apart from barley, which averaged only 16s. 1d. per cwt. as against 17s. 3d. in October, cereal crops showed little change. Wheat averaged 12s. 7d. per cwt., 1d. more than in the previous month, but this slight advance was insufficient to maintain the index number at the October level, and a fall of one point is recorded. Oats also are slightly lower, in spite of the fact that the average price, 10s. 2d. per cwt., was the same in November as in October.

Both fat cattle and fat sheep, which have been slowly declining during the past few months, continued the downward movement, although actual prices show little change, and were, in fact, a shade higher in the case of sheep. On the other hand, fat pigs, for the fourth successive month, showed an advance, and average prices during November were higher than in any other month of 1924. The index number for fat pigs, 45 per cent. above pre-war, was, it may be noticed, only 2 points below that for fat cattle, and also only 2 points below the figure in the corresponding month last year.

Store cattle were about 10s. per head cheaper in November than in October, and the index number was 5 points lower on the month. Store sheep and pigs, however, together with dairy cows, were practically unchanged in price, although variations between October and November in the basic years are the cause of appreciable changes in the index numbers. It is noticeable that the figures for both store cattle and store pigs are distinctly lower than for fat cattle and pigs, while store sheep remain at a slightly higher level than fat sheep.

Eggs advanced about 7½d. per dozen on the month, averaging 3s. 3d. per dozen, but this advance is less than the corresponding advance in pre-war days, and the index number fell 5 points; they remained relatively dear during November, however, at 84 per cent. above pre-war prices. Fowls and ducks declined appreciably, and although the fall was to some extent counter-balanced by a rise in the price of geese, the index number for poultry shows a fall of 9 points. Dairy produce was practically unchanged on the month, milk, butter and cheese each varying by only 1 point as compared with October.

A slight recovery in hay prices was sufficient to raise them to about pre-war level, but the market remains very depressed,

and hay is still by far the cheapest kind of agricultural produce, in comparison with pre-war. Vegetables generally were rather dearer than in October, except for brussels sprouts, which averaged only 11s. 4d. per cwt., or 8 per cent. more than the price in the corresponding month in 1911 to 1913. Carrots also averaged 8 per cent. above their pre-war price, and cabbage was cheap at 18 per cent. above pre-war, but cauliflowers at 65, celery at 55 and onions at 45 per cent. higher than in 1911 to 1913, realised relatively high prices.

Index numbers of different commodities during recent months and in November, 1922 and 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1922.	1923.	1924.			
Commodity.	Nov.	Nov.	Aug.	Sept.	Oct.	Nov.
Wheat ...	32	22	59	61	69	68
Barley ...	34	25	75	107	103	89
Oats	38	24	38	38	47	45
Fat cattle ...	48	47	56	54	48	47
Fat sheep ...	87	77	100	100	93	90
Fat pigs ...	94	47	34	39	40	45
Dairy cows ...	74	57	57	59	62	60
Store cattle ...	29	25	48	38	41	36
Store sheep ...	93	88	129	130	112	94
Store pigs ...	148	75	29	29	29	33
Eggs... ...	98	92	63	71	89	84
Poultry ...	75	58	66	75	67	58
Milk	90	75	58	58	81	82
Butter ...	72	64	67	72	73	74
Cheese ...	55	73	66	42	39	38
Potatoes ...	8	80	72	99	154	168
Hay	45	—1*	3	1	-3*	1

* Decrease.

* * * * * *

THE MINISTER ON THE AGRICULTURAL POSITION.

THE Minister of Agriculture, the Rt. Hon. E. F. L. Wood, M.P., addressed a meeting of the Essex Branch of the National Farmers' Union at the Shire Hall, Chelmsford, on 5th December, and was very heartily received.

Mr. Wood said that there were a good many reasons why it afforded him particular pleasure to be able to address such a large and representative gathering. It so happened that that was the first public meeting he had had the honour of addressing in his capacity as Minister of Agriculture, and he was glad that it should be at a meeting of Essex farmers, because, although he was born and bred a Yorkshireman, and therefore bound to think that Yorkshire was the best county, yet he would

willingly concede pride of second place to Essex. For a good many years past he had himself been a member of the National Farmers' Union, and having been brought up and all his life moved among farmers, he did not feel in strange company. He would say one thing at the outset. He did not suppose it was possible to make any greater mistake than to try to conceive of the agricultural industry as a single industry, of which easy or single generalisations held true. The conditions were far too different and too diverse. It was that reason that lay at the bottom of their minds when they felt indignant at hearing those who lived in the towns attempting to suggest that those in the country districts were in any way less intelligent than the townspeople themselves. On the contrary, there were very few industries in the country that were more skilled, in the strict sense of the word, than was the industry of the farmer. The farmer, and, within the sphere of his responsibility, the labourer also, had to be at one and the same time something of a business man, of an organiser, of a judge of stock, and, when all those things had been rolled together, there had to be added to the kind of sausage which came out of that machine in liberal degree the qualities of patience and perseverance. The farmer had needed those qualities of patience and perseverance lately. There might be a great many farmers present who, like himself, had lost money in farming in the last few years. But he thought it was permissible to look rather more cheerfully on the present condition of agricultural prospects.

The Tide Turning.—In the six years since the war agriculture had been through a great many vicissitudes, but he thought it was now permissible to hope that they were coming within sight of more stable conditions, and that the tide was slowly turning in their favour. The past two years' index number of prices had been more or less steady at about 60 per cent. above the 1911-13 figure, and lately there had been a decided trend upward. Those figures gave ground for some encouragement, and indicated that the prospects for cereal growing, which had been most hit by the slump, were rather more hopeful. Wheat prices in this country were governed by the world production and world consumption of wheat, and he noticed that the last estimate given by the International Institute of Agriculture at Rome was that the present exportable surplus of cereals was 441,000,000 cwt., and the requirements were estimated at 433,000,000 cwt. They would observe that there was a very small margin left. If they put side by side with that

the fact that in the East the consumption of wheat was steadily growing, there was considerable indication that wheat could not be cheaper in 1925 than it was in 1924. That view was supported by the fact that the price in Liverpool for future deliveries was higher than for deliveries made immediately. On the whole, therefore, he thought that there was some solid ground for thinking that as regarded the cereal part of the agricultural business prospects were better.

The Coming Conference on Agriculture.—"Therefore," proceeded the Minister. "I think it is permissible to say that agriculture is winning through the abnormal conditions that followed after the war. Certainly it is true that we are now in a position to judge better of its future prospects as we gradually get these world forces under review, and we are enabled to estimate their value. It was under those conditions that the Government thought it right to suggest to the three great sections of the agricultural industry that they should come together, and, in co-operation, do their best to produce for the information and guidance of the Government and the country an agreement on the main lines of agricultural policy, that might take its place in the national policy, and that might reasonably be expected to be durable and permanent. And we did that because we recognise that bound up with the prosperity of agriculture are great national objects and ends. That was fundamental to our thought.

And the second thing that induced us to think that procedure by conference was wise was this: that the industry of agriculture, less than any other industry, can afford to be the plaything of party politics.

The third reason was that agriculture, less than anything else, can afford to experience sharp reversals of political policy. We have had experience of them, and the experience we had four years ago tends to emphasise the wisdom of trying to proceed by way of permanent agreement rather than by way of trying to adopt spectacular expedients that may not prove of lasting value.

Lastly, we had present in our minds that any policy applied to agriculture that was to make good its claim to the title of 'national' must be a policy that could carry with it the willing assent of the industrial elements of our country. Therefore we said: 'Party prejudice, unfortunately, is often strong; old misunderstandings among the industrial population are deep-seated; in what better way could we seek to overcome

prejudice and remove misunderstanding than by giving first the three sections of the industry themselves a chance of putting up for the consideration of the whole country a policy on which they themselves will be agreed?' "

The Possibilities of the Conference.—Continuing, the Minister said: "That conference, if and when it is established, will be invited to make what recommendations it may think fit as to the means by which the arable acreage of England and Wales may be maintained. On that depends the population that can be maintained on the land; on that depends the employment that can be given to that population; and, on the arable acreage also depends the amount of produce that the soil of England can produce. I hope that the conference will, without delay, be able to get down to business and explore a great many questions that will arise out of this review. But when it does so, I hope it will not lose sight of the fact that the terms of reference that have been given to it do not only suggest, or rather invite the conference to suggest, action that may be taken by the State for the benefit of agriculture, but they also invite the conference to suggest what measures, if any, can be taken by the agricultural industry itself to help itself. That, I think, is not less important. It is, after all, worth remembering that it was from the ranks of British agriculture that sprang what we should be right in terming one of the agricultural revolutions of the 18th century. And it may be that the introduction of new methods, such, for example, as sugar beet, may conceivably turn out to be the stones in the bridge leading across the gulf from loss to profit. Do not let us shut our eyes to these possibilities."

Sugar Beet.—With regard to sugar beet, the Government intended to continue the policy of their predecessors, and he hoped that at the end of the ten-year period they would have succeeded in establishing in this country a new industry, and thereby afford the producer a means of growing a new crop, and disposing of it at a profit. When proposals were made he hoped farmers would look at them with care, and be prepared, if they were satisfied as to their wisdom, to support them.

New Methods in Agriculture.—Dealing with new methods of farming, he said that there was to-day, somehow, an inadequate liaison between the man of science engaged on his research and the working farmer engaged on the day-to-day cultivation of his soil. That was less true of Essex than of most parts of the country, due largely to their excellent Institute of Agriculture, of

which he had heard before he came there, and of the excellent work of such public men as Mr. Hasler and Mr. Dent. He was trying at the Ministry to devise some scheme by which they could get their scientific results available in easier and more workable form. The food prices inquiry obviously had a bearing on agriculture, and all those things of which he had been speaking together had a vital bearing on the problem of wages now being settled by collective bargaining, made statutory by the Act of last Session.

Organisation.—He had occasionally met farmers apt to deplore the growing organisation of their labourers. Farmers could not set to work and organise themselves and grudge their labourers the right to organise as strongly as they could, too. When everybody else in the country was organised, it was essential for the agricultural industry to be organised also. Landowners, farmers and labourers were all paddling the same canoe, and the better they were organised in their own sections, as long as they remembered they were all paddling the same canoe, the better for the country.

The Government were fully alive to the importance of agriculture in the general scheme of national industries. They would do all they could to advance the legitimate interests of agriculture, and he asked them all in their organisation to join hands with the Government in trying to restore the business of agriculture to what it ought to be—the premier, gilt-edged security of the nation, in the interests of the nation as a whole, and to whose well-being the prosperity of the country was vital.

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FARM WORKERS' BUDGETS.

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III.—COST OF CLOTHING AND HOUSEHOLD REQUIREMENTS.

As the group of budgets previously dealt with* left something to be desired in regard to the details provided it appeared necessary to attempt another inquiry. In was then determined to ask for as many details as possible except with regard to the distribution of total expenditure on foodstuffs over different varieties of goods. Had the persons making returns been asked to itemise

* This *Journal*, Dec., 1924, p. 812.

the expenditure on foodstuffs the form of return would have been too long and cumbersome to present to voluntary collectors. On the whole, the form adopted served its purpose successfully, and the inquiry yielded information both as regards income and expenditure of a type which has not previously been obtainable. It may be, however, that the quantity and the nature of the detail covered by the form compelled the voluntary collectors to select families which were somewhat above the average both as regards intelligence and income in the districts from which returns were obtained. A study of individual forms and of the general results gives this impression. But in this study particular attention should be given to details of income other than cash wages, and the statements regarding expenditure on clothing and household requirements. The former are important from the social rather than the industrial point of view; the latter are important because they indicate that it is possible to obtain information for which previous budget inquiries have failed to ask or which they have failed to secure.

The counties from which returns were obtained, with the number from each, are as follows:—

Gloucester ...	3	Sussex ...	1
Norfolk	5	Worcester ...	2
Oxford	5	Surrey... ...	1
Lancashire ...	2	Essex	1
Yorkshire ...	4	Kent	2
Dorset	2	Somerset ...	1
Northants ...	2	Cornwall ...	1
Northumberland	2	Bedford ...	1
Hampshire ...	2	Suffolk ...	1
Lincoln	4	Nottingham ...	1
		TOTAL ...	43

For the small number of returns they are very well distributed over the country. One result of this distribution, however, is to make the average earnings somewhat higher than the national average wages of farm workers as calculated from the rates of wages ruling in the different counties, weighted by the estimated number of workers in each county.

Employment and Wages.—For the purposes of analysis the 43 families have been divided into two groups: (*a*) 25 families containing not more than three children; (*b*) 18 families containing more than three children. The summary of the number of persons employed and the wages earned during one week at the end of March or the beginning of April, 1924, is as follows:—

Table VIII.—Employment and Wages.

Groups.	Number of Workers.		Wages.					
Total of 43 Families.	Regular.	Casual.	Regular Workers.		Casual Workers.		Total.	
			s.	d.	s.	d.	s.	d.
Total	57	9	1,513	9½	68	6	1,582	3½
Average number of workers per family	1.30	0.21	35	2½	1	7	36	9½
25 Families with 3 children, or under.								
Total	32	4	863	1½	11	0	874	1½
Average number of workers per family	1.28	0.16	34	6¼	0	5¼	34	11½
18 Families with more than 3 children.								
Total	25	5	650	8	57	6	708	2
Average number of workers per family	1.39	0.28	36	1¾	3	2¼	39	4

The average weekly cash wages of all regular workers, including adults and youths, were nearly 26s. 7d., and the average cash earnings of the few casual workers in one week were 7s. 7d. The wages, however, did not constitute the whole of the cash income, for, in each group of families, some income was received as pensions—either disability pensions for war service or old-age pensions as a result of the maintenance of aged relatives. The total cash incomes were :—

	Earned Income.		*Pensions.*		*Total.*		*Average.*	
	s.	d.	s.	d.	s.	d.	s.	d.
Families with 3 or fewer children	874	1½	47	0	921	1½	36	10
„ „ more than 3 „	708	2	4	0	712	2	39	6¾
Total 43 families ...	1,582	3½	51	0	1,633	3½	37	11¾

Weekly Expenditure.—The expenditure of this income on items which are purchased weekly is given in Table IX. The classification of items of expenditure is similar to that used in the previous report on budgets, but in this case no attempt was made to secure returns of expenditure on separate items of foodstuffs. The expenditure on each class of items has been averaged over the whole of the families, but it will be understood that some of the families did not pay rent. Each other class of expenditure can fairly be averaged over all the families, for the "Miscellaneous" class includes tobacco and newspapers, besides fares, repairs to cycles, and other items which might equally occur in other weeks in any of the families. The balance of income shown is that remaining when the items of ordinary *weekly* expenditure have been met, and, as will be shown later, this may be more than absorbed in expenditure on

other necessaries. While it is rather surprising to find a balance of income over ordinary weekly expenditure at this time of the year, it must be remembered that the incomes of these families are high in comparison with the average weekly cash wages of farm workers. As may be seen, the national average wages, which are estimated to be about 28s. per week, an amount that would not meet the ordinary weekly expenditure of either of these groups of families.

Table IX.—Farm Workers' Weekly Budget.

43 Families.	Total.	No. of occurrences.	Average.	Average for 43 families.
	s. d.		s. d.	s. d.
Rent	93 4½	28	3 4	2 2
Foodstuffs	965 2¼	43	22 5½	22 5½
Cleaning Materials	58 1¼	41	1 5	1 4½
Insurance	74 10¾	43	1 9	1 9
Fuel and Light	226 0	43	5 3	5 3
Miscellaneous (including Fares) ...	48 8½	21	2 4	1 1¼
Total Expenditure ...	1,466 3½	43	—	34 1¼
Total Income	1,633 3½	—	—	37 11¾
Balance (excluding Clothing) ...	167 0	—	—	31 0½

25 Families with 3 or fewer Children.	Total.	No. of occurrences.	Average.	Average for 25 families.
	s. d.		s. d.	s. d.
Rent	64 9	19	3 5	2 7
Foodstuffs	510 5¼	25	20 5	20 5
Cleaning Materials	35 7	25	1 5	1 5
Insurance	43 1	25	1 8¾	1 8¾
Fuel and Light	136 9¾	25	5 5¾	5 5¾
Miscellaneous (including Fares) ...	27 2½	12	2 3¼	1 1
Total Expenditure ...	817 10½	25	—	32 8½
Total Income	921 1½	—	—	36 10
Balance (excluding Clothing) ...	103 3	—	—	4 1½

18 Families with more than 3 Children.	Total.	No. of occurrences.	Average.	Average for 18 families.
	s. d.		s. d.	s. d.
Rent	28 7½	9	3 2½	1 7
Foodstuffs	454 9¼	18	25 3¼	25 3¼
Cleaning Materials	22 6¼	16	1 5	1 3
Insurance	31 9¾	18	1 9¼	1 9¼
Fuel and Light	89 2¼	18	4 11½	4 11½
Miscellaneous (including Fares)	21 6	9	2 4¾	1 2¼
Total Expenditure ...	648 5	18	—	36 0¼
Total Income ...	712 2	—	—	39 6¾
Balance (excluding Clothing)	63 9	—	—	3 6½

Expenditure on Foodstuffs.—The constitution of the families makes the average family for the whole group equal to nearly 3.9 "men" for dietary purposes; the average for the group with three children and less being equal to 2.98 men and that for the group with more than three children equal to 5.14 men or dietary units. The expenditure on foodstuffs is about 5s. 9d. per man, or 4s. per person, per week over the whole of the families. In the group of larger families the expenditure on food only amounts to 4s. 11d. per man and 3s. 2½d. per person; and in the group of small families to 6s. 10d. per man and 5s. 2d. per person.

Allowances and Home Produce.—In addition to the cash income received and expended as stated the whole group of families received and used or consumed other goods. Part of these were received as allowances in kind in lieu of wages in employment, and part were produced at home. No attempt has been made to divide the allowances and the allotment produce between the groups of larger and smaller families.

Cottages.—Eleven families stated that they lived in rent free cottages, of which the rental value was estimated to be 34s. 6d., or about 3s. 2d. per cottage. This may be compared with 3s. 4d. per cottage for the families which actually paid rent, and appears to be a fair estimate. Four other families lived rent-free, and if the value of the four cottages occupied is taken at the same figure, the total value of the cottages which were supplied rent-free would be 47s. 2d.

Milk.—Of the 48 families, 11 returned milk received as allowances from employers. Eight families stated that they received 62 pints of new milk valued at 14s. 0½d., and three families returned 22 pints of skimmed milk valued at 1s. 8d.

Potatoes and Bacon.—Only three families made any return of potatoes received as allowances, and the total quantity used during the week was 45 lb. valued at 3s. 4d. The receipt of pork or bacon was returned by four families, the total quantity being 17 lb., valued at 17s. 8d.

Total Value of Allowances.—The only other form of allowances returned was that of coal, of which two families received 8 cwt., valued at 7s. 7d. The total value of the allowances in kind, including cottages, was estimated to be 91s. 5½d.; or, if the allowances are spread over the whole of the families, an average of 2s. 1½d. per week.

Home or Allotment Produce.—Of the 48 families, seven stated that they consumed 21 lb. of bacon which was home produce,

and 13 families consumed 160 eggs which were produced at home. It has to be remembered that the returns were collected at a period when eggs were plentiful and comparatively cheap. On the other hand vegetables in cottage gardens or on allotments are comparatively scarce at this season of the year and only 12 families stated that they consumed, during the week to which the returns apply, vegetables produced in their gardens or allotments. It is difficult to state exactly the quantity of home-grown vegetables consumed, because some returns were made in the form of "two heads of broccoli," &c., but it is estimated that these 12 families consumed:—green vegetables 60 lb., roots 36 lb., various vegetables 55½ lb., which were produced on their gardens or allotments. This period, however, cannot be taken as representative of the whole year.

Allotments.—More families returned the holding of allotments than made returns of consumption of allotment produce. The total area of allotments returned was nearly 6¾ acres (1,075 poles). These were held by 27 families and the average is nearly 40 poles (one-quarter acre) per family of those holding allotments. In some cases rents of allotments were not stated; but for 987 poles the total rent given was £29 17s. 3d., being about 7d. per pole or nearly £4 15s. per acre. The value of home produce cannot be taken as income apart from the rent of allotments, cost of seed, &c., and possibly labour.

Expenditure on other Necessaries.—On previous occasions when inquiries into the cost of living of farm workers have been made it has not been found possible to include expenditure on such items as clothing or house-linen and household utensils, which are only occasionally purchased, and it has been somewhat difficult to allocate expenditure on repairs of boots and clothing. Estimates of cost of clothes made by the Farming Costs and Costs of Living Committee of the Agricultural Wages Board in 1918 were based on very few actual data, although they were probably fairly accurate. For a family of about 5½ persons (which is almost exactly the same size as the average of the 43 families with which this study deals), the estimated expenditure on clothes was 3s. 6d. per week in 1914 and 6s. 8d. in 1918,* but household necessaries like linen and utensils were not included in these estimates. It seemed desirable, therefore, to attempt to collect information on expenditure on clothing and repairs to clothing and boots,

* Cmd. 76, 1918.

together with household necessaries. This inquiry has yielded results which are more detailed and on the whole more reliable than any hitherto available, and although they are to be taken as tentative results only, they do provide information which is both interesting and useful.

Repairs of Boots and Clothing.—Persons making the returns were asked whether they could state "the average monthly cost" of repairing boots and of materials for repairing clothing, including cotton and thread, cloth and wool. The stated cost of repairing boots for 33 families for a month was 148s. 2d., or an average of 4s. 6d. per family. The range of stated costs was between 15s. and 1s. per month, but the family which returned 15s. consisted of six persons.

The stated cost of materials for repairing clothing for 32 families was a total of 74s. 5d. or an average of 2s. 4d. per family. The range of stated costs was between 10s. and 6d., but more generally between 6s. and 1s. per month. The family which returned 10s. per month consisted of nine persons.

Cost of New Clothing and Boots.—Persons making the returns were also asked if they could state the "actual cost of new clothes of all kinds purchased for a man, woman, or child for one year."

As regards cost of new clothing and boots *for a man* 14 returns were obtained. These showed a total of £83 2s. 3d. or an average of £5 18s. 9d. per man. The range was from £13 19s. 2d. to £1 5s. 3d. but the man for whom the highest return was given was earning 45s. per week. There was also another case in which the cost was stated to be over £13, but in this case the family income was 54s. per week. The next highest case was £10 11s.

For the cost of new clothing and boots *for a woman* 13 returns were obtained, and these showed a total of £66 5s. 1½d., or an average of £5 1s. 11d. The range was from £19 14s. 10d. to £1. There was, however, another case quoted at £10; otherwise the range was between £6 14s. 5d. and £1. Again the highest cost was connected with high wages of the head of the household.

For the cost of new clothing and boots *for a child* under 14 years only 10 returns were obtained. These showed a total of £25 11s. 3d. or an average of £2 11s. 1d. The range was between £7 2s. 6d. and £1.

Estimates of Cost.—If it was not possible to state actual cost of clothing, the persons making the returns were asked if they could " estimate the cost of new clothes and boots required during one year by a man, woman, or child." All the estimates received were made by families which did not attempt to state the actual costs.

For the estimated cost of new clothing and boots *for a man* 17 returns were received, showing a total of £76 5s., or an average of £4 9s. 9d. per man. The range was from £10 to £2, but more generally from £8 15s. to £3.

For the estimated cost of new clothing and boots *for a woman*, also 17 estimates were received. These made a total of £71 7s., or an average of £4 3s. The range in this case was from £9 5s. to £1.

For a *child under* 14 *years* of age 15 estimates were obtained and these showed a total of £40 8s. 6d., or an average of £2 13s. 11d. It will be recognised by anyone conversant with the domestic economy of farm workers' families—or indeed of some other families—that it is most difficult to state the actual cost or even to estimate the cost of clothing a child when there is more than one child in family, for the simple reason that clothes " descend " from one child to another.

Actual and Estimated Costs of Clothing.—Comparing the returns of actual costs and estimates of costs of new clothing and boots it is interesting and somewhat surprising that the estimates are lower than the actual costs, except in the case of children. This may be because only the more thrifty families, which have the more money to spend on clothing, are in a position to state actual costs; or, it may be, because many families do not know the actual cost of clothing. There are, however, other considerations: the family income, and the proportion of the family income which is necessary to meet weekly expenditure on food and fuel, etc., has the most important influence on the purchase of clothing, and it may be possible that some families were unwilling to state expenditure when it was very small. Moreover, it is obvious that there are very wide variations in the expenditure on repairs of boots and materials for repair of clothing, and these variations would have considerable influence on the amount spent on new clothing and boots.

Altogether some 31 families stated actual costs or estimates of the costs of new clothes and boots. The number of statements and the average amounts are as follows:—

Table X.—Clothing and Boots.

	Actual Costs.		Estimated Costs.	
	No. of Returns.	Average Amount.	No. of Estimates.	Average Amount.
		£ s. d.		£ s. d.
Man	14	5 18 8¾	17	4 9 8¾
Woman	13	5 1 11	17	4 3 11½
Child	10	2 11 1½	15	2 13 10¾

Nine families gave no information, and for three families it was stated that no money was spent on new clothing or boots.

House-linen, China, &c.—In addition to the above information on clothing and repairs the persons making the returns were asked if they could state "the actual cost of house-linen, including sheets, blankets, towels, etc., for one year." Twenty-four returns were made, showing a total of £59 13s. 9½d., or an average of £2 9s. 9d. per household. The range was from £5 13s. 1d. to 10s. Persons making returns were similarly asked if they could state "the actual costs of china and utensils for one year for the upkeep of the household supply." The returns of this item numbered 29 and showed a total of £30 2s. 7d. and an average of £1 0s. 9d. The range of returns was between £3 and 7s. 6d.

Whatever may be said of these costs they cannot be said to be unreasonable, especially when it is remembered that the average size of families is large, being over five persons per family. In the case of both house-linen and utensils it has to be borne in mind that expenditure is not only affected by income and by the proportion of income needed for weekly expenses for food and fuel, but also by the state of the equipment of the household at any given time.

Summary.—It would be both unfair and unwise to average the expenditures on new clothing and boots, and on household equipment, and apply the averages to the whole of the families as an estimate of actual expenditure on these items, because it is fairly certain that the expenditures of the 43 families would not reach the total which would be obtained in this way. As regards repairs, however, this is not the case, and the average of the statements received can be fairly applied to the whole of the families. The 33 families which made returns averaged 6s. 10d. per month, say £4 2s. per annum or 1s. 7d. per week. Taking the balance over the weekly expenditure on food, fuel, etc., of 3s. 10½d. per week this would leave a

balance of 2s. 8½d. or thereabouts for the purchase of new clothing, utensils, etc.

Although it would not be fair to apply the average expenditure on new clothes and utensils over the whole of the families as an indication of actual expenditure, it might be fair to apply it as an indication of need.

	Average Cost per head returned. £ s. d.	*No. of persons.*	*Estimated Total necessary per family. Cost.* £ s. d.
Men and Youths* ...	5 2 9	1.44	7 8 0
Women and Girls* ...	4 11 0	1.21	5 11 2
Children	2 12 10	2.95	7 15 11
		Per family	£20 15 1

* Over 14 years old.

Thus if this figure were taken as the indication of the clothing requirements of the families it would mean a sum of about 8s. per week. If house-linen, china and utensils were added, it would make a total of about £23 5s. per annum, or 9s. per week. As this is far in excess of the sum of about 2s. 8½d. a week which is available after meeting the current expenses of food, fuel, and repairs of clothing and boots, it is obvious that the provision of new clothes largely depends upon extra earnings, mainly in the harvest seasons. This corresponds with what is known of the customs and habits of the farm workers' families.

On the whole, this group of budgets has been supplied by families in a position somewhat superior to that of the average farm worker, but they are valuable as indicating with a reasonable degree of accuracy the sources of income, whether in cash or in kind, apart from weekly cash wages, and that they also indicate the amount of expenditure on items which are not purchased weekly or entirely from the weekly cash wages.

As regards the weekly expenditure on such necessaries as food and fuel a comparison of the results of these budgets and of those previously dealt with will be made separately.

(To be concluded.)

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DALES PONIES.

ROY B. CHARLTON.

IT is very remarkable that so few people outside of the Dales Pony country appeared to know of the existence of this hardy breed of native pony before the Dales Pony Improvement Society was founded in the year 1916. The British native breeds of pony are famous throughout the world for their hardiness, sure-footedness, durability, mildness of temperament, ability to withstand the hardships of their wild surroundings (such as scarcity of good food in winter time), soundness of constitution, and freedom from hereditary diseases. The Dales pony counts as one of Britain's ancient native breeds of mountain or moorland pony, in the same way as does the Welsh, the Exmoor, the Dartmoor, or the New Forest pony, and as time has rolled along, the Dales pony, like other mountain and moorland ponies, has had its ups and downs.

For a very long period, up to 50 years ago, the western dales of Northumberland, Durham, and North Yorkshire, were busy centres of lead mining, and Dales ponies were used in great numbers about the mines, and for carrying the lead ore to the washing places in the dales, and from there right to the ships (for export) at places like Newcastle-on-Tyne.

The ancient pony roads across the moors can yet be traced, and are known to-day as the "lead roads." The ponies made these long journeys in teams, each team consisting of about 22 ponies, all loose headed, and each pony carrying about 16 stones of lead in panniers upon its back. The ponies were specially bred for this particular purpose—to carry a great weight over extremely rough country, and to get along at a fast pace. Generations of breeding for this hard work developed the breed of pony into an animal of wonderful strength and activity.

Another very strong factor for the good qualities of the Dales ponies was that the teams were privately owned. Young horsemen of the Dales strove to get together a team of their own, and took a very special pride in their ponies. Dalesmen have ever been sportsmen, and over a very long time, right up to the present day, their most enjoyable sport has been the holding of trotting matches with their ponies. The writer possesses a collection of ancient stud cards, which invariably mention great trotting feats by the Dales pony advertised, or by some of its ancestors—such performances as 10 miles on the hard road in 33 minutes with 12 stones up, etc.

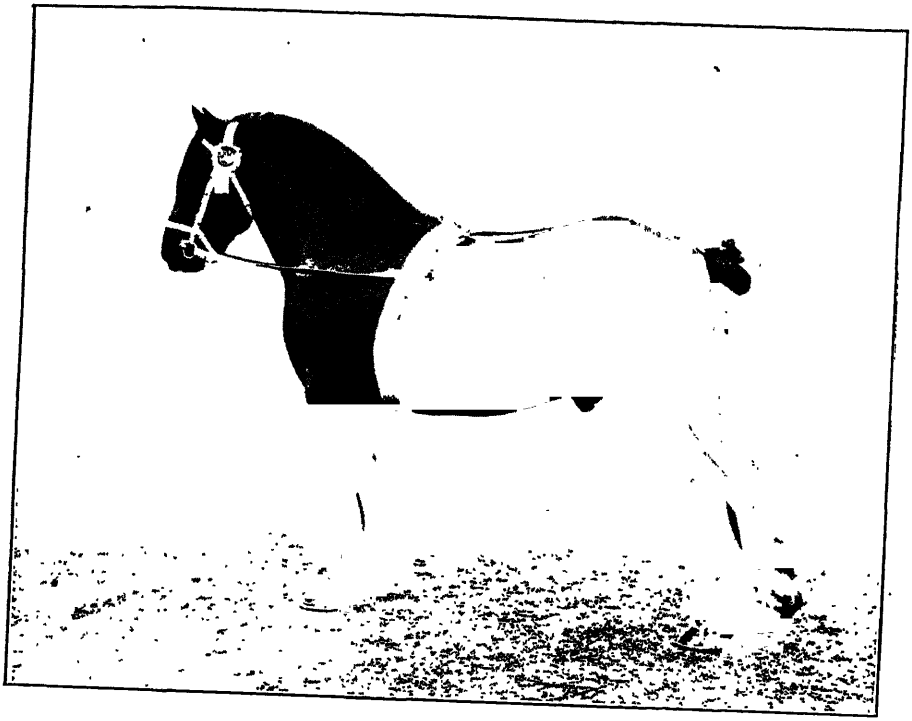

FIG. 1.—Dales Pony Stallion. (Linnel Cornet.)

FIG. 2.—Dales Pony Mares. (Stanhope Beauty and Robinson's Gipsy.)

This year at the Stanhope-in-Weardale Agricultural Show, the chief events of the day were the Dales pony classes, and the trotting races, for which the sum of £40 was given as a first prize. Dalesmen old and young were there to see the ponies and the trotting, and their enthusiasm was great. Their keenness, and love for this old-fashioned sport, accounts to a very great extent for the good qualities of the ponies, which can yet be found in large numbers in these wild dales. The ponies are great walkers, and very fast trotters, but they have never been trained to gallop.

Description of the Breed.—The present-day Dales ponies are of a most powerful and cobby build. They average about 14 hands in height, the maximum height at which they may be registered being 14.2 hands. Many of them are whole black in colour; other prevailing colours are brown, bay and grey, but chestnut and broken colours are never seen in the pure-bred Dales pony. They have long flowing manes, and grow quite a lot of fine silky hair on their heels. Hair is a feature which is never forgotten by the lover of the true Dales pony. They have very sharp and good action, and put their feet down straight. Their heads are neat and pony-like, with ears small and neatly set, throats and jaws fine, necks strong and inclined to be too short.

The shoulders are strong, but too steep and upright; they want greater length of shoulder blade. (This point is very carefully watched when pony stallions are selected for the Government premiums.)

Their backs, loins, and hindquarters are all that could be desired, with well-sprung ribs, great muscle and strength, and with tails well set. They have the very best of feet, legs and joints, their knees and hocks are perfect, and they have immense bone below the joints.

Their constitution is very good, in fact, hereditary unsoundnesses are almost unknown in the breed. They are, like most of our mountain and moorland ponies, extremely sensible, and above all, they are game and alert to a degree.

The Dales pony brood mares of Teesdale and Weardale do not run semi-wild, like the Fell pony mares of the Lake District, but are expected to do quite a lot of work about the small farms all the year round, with the result that although they are generally turned out at nights, even in winter, they get a bite of sweet hay, just when they really need it. The

young Dales ponies as a rule are sold as foals, in the September of their first year at, say, Tow Law, Co. Durham. By getting rid of her foal in the early autumn the mare is enabled to keep her condition.

Present-day Improvements.—Within the last 50 years, changes have taken place which have had their effect upon Dales ponies. Many of the mines have been closed down, and railways have been made to those that are still working, with the result that Dales ponies are not now wanted in anything like such great numbers for the lead mines.

The small farmers of the dales who used to keep their 13.2 to 14 hands Dales pony to do all the work about the farm, have purchased mechanical grass cutters, hay tedders, etc., and to work these machines larger ponies have been bred, by crossing the Dales pony with small Clydesdale horses. The first cross to Clydesdale usually results in a wonderfully active and powerful animal—an animal which sells when 2½ years old at a good price—but to put a filly so bred to stud, and to expect to produce offspring anything like uniform, ends in disappointment.

This is where the work of the Dales Pony Improvement Society is distinctly showing itself; the old breed of Dales was in danger of going out of existence, but fortunately for the ponies, the Society from its inception set its face against the Clydesdale cross, or indeed any outcross. The Society set to work and found every available pure-bred Dales pony sire, and backed by the Ministry of Agriculture, gave premiums to the best of these. The result is that, after eight years of hard work, the Society has taught the owners of pony mares to realise that the pure Dales pony is a much more valuable animal than the cross-bred cob of a few years ago, and as each season comes along the improvement in the young stock can be plainly seen. One has only to go to an auction sale, such as the sale of registered Dales ponies, held at Tow Law, Co. Durham, in September of each year, to notice the distinctly larger prices offered for those ponies which have the appearance of being pure bred.

The fact that the War Office has recently taken a great number of 14 to 14.2 hands ponies, all of which had to be pure Dales ponies, showing no sign of outcross, should greatly encourage owners of good class Dales pony mares to put their mares to stud.

It is, the writer thinks, an acknowledged fact that Dales ponies are the most saleable kind of horse that the North of England is producing to-day. There seems to be always a ready market for them. The outer world appears to have discovered them only recently, but they are being sold as deer stalking ponies for Scotland, and the Spanish Government is buying Dales pony stallions. They are really booming.

The mother society of British ponies is the National Pony Society, which has its headquarters at 12, Hanover Square, London, W.1. This society publishes a stud book, with sections for the registration of ponies of the different mountain and moorland breeds, and Dales ponies have their section, which is a complete register of their pedigree ponies.

London Pony Show.—In March of each year the National Pony Society holds a show at the Agricultural Hall, Islington. Every breed of British mountain and moorland pony can be seen at the show, and to anyone who is interested in live stock it is an education and an impressive sight to see all these native ponies grouped together in their different classes. Dales ponies are always well represented at the London Pony Show.

It is the duty of the convener of each breed of pony to see that the animals sent to the London Pony Show are true representatives of their own particular breed. It is, therefore, in the opinion of the writer, the best place to see, and learn to know, our different British mountain and moorland ponies.

Comparison with Fell Ponies.—Before closing this article we might usefully refer to the similarity which exists between the two breeds of ponies of the North of England—the Dales and the Fell ponies.

To go well back into the history of these ponies we must see that they would originally be one and the same. The conditions under which the animals have lived; the purposes for which they were required; fashions, and other forms of interference by man have, over a long period, divided the ponies into distinct types.

The semi-wild Fell pony mares of the Lake District roam on the high fells throughout the whole year; they can be seen in the spring of the year round about the village of Bampton, in Westmorland, or on Caldbeck Fell, or the back of Skiddaw, in Cumberland. They have with them their previous summer's foal, a yearling, and perhaps a two-year-old; these trail after the dam, and all look as if they really required more attention. This is rather different from the life of the Dales pony

as already outlined above, for while the Dales ponies work and are better fed, their sisters on the Lake District Fells are probably scraping the snow away to find a patch of poor grazing.

It is the custom of owners of Fell pony brood mares to allow the mares to run in the above-mentioned semi-wild state, and not to ask them to do any form of work. Very few of these mares have ever been handled. Their offspring are left until they reach the age of 2½ years, when they are taken in droves to places like Brough Hill Fair and sold in their rough unbroken state.

The Dales pony therefore tends to grow into a stronger animal than the Fell pony. The rules of the Fell Pony Society do not allow the registration of mares exceeding 13.2 and stallions 14 hands.

Breeders of both Dales and Fell ponies are keenly interested in the pedigree of their ponies. The Ministry of Agriculture, for a number of years past, has granted 4 Premiums to Dales pony stallions, and 5 Premiums to Fell ponies; the War Office now continues this practice. The competition for these Premiums is very keen. The Premiums are usually awarded in April—those for Dales ponies usually at Bishop Auckland, in Co. Durham, and those for Fell ponies at Penrith. The stallions are kept in hand throughout the summer, and are shown in good condition, and in increasing numbers.

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SEASONAL DISTRIBUTION OF EMPLOYMENT IN AGRICULTURE.

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ATTENTION has already been drawn in this *Journal* to the importance which attaches to regularity of employment from the point of view of the internal management of farms.* There is, however, another aspect of the question. Both the majority and minority Reports of the Poor Law Commission (Cd. 4499. 1909) indicted casual labour as one of the root causes of pauperism. From a national standpoint, therefore, its incidence and character in relation to farming systems are significant, and the labour requirements of methods of cropping assume an importance beyond the problems of the internal economy of the farm.

* This *Journal*, July, 1922, p. 319, and Aug., 1922, p. 447. "Labour Organisation on an East Midlands Farm," A. Bridges.

Early Farming Systems.—The profound connection between the labour supply and farming systems is seen in all phases of British agriculture. The primitive rotation of manorial husbandry, with its alternations of winter corn, summer corn and fallow, utilised the definite and regular amount of labour available by custom for the cultivation of the demesne lands. Seasonal pressure was reflected in the extra "boon" work called for at the spring and autumn ploughings and at harvest, and the rural organisation of the period required the existence, side by side with the demesne lands, of the peasant holdings, from which could be drawn labour to supplement that of the manorial servants who formed the permanent nucleus of hands for the regular daily tasks on the lord's holding. Even in the 13th century, however, was to be found a class of migratory piece-workers—harrowers, shearers, etc.—and harvest work called in the aid also of day-labourers from the towns.*

With the breaking up of customary ties binding the manorial lord and the tenant worker, and in the disorganisation which accompanied the development of sheep farming in the 15th and 16th centuries, the shortage of labour was the underlying motive for the framing of the new farming policy under which a considerable area of arable went down to grass. For the maintenance of the food supply the legislation of the period sought to re-establish and stabilise the rural population, and though permitting migration at harvest from the grass areas to the arable districts, it sought also to impose compulsory service on the town artificer in getting in the farmer's hay and corn.

It was, indeed, the existence of a large class of day-labourers with their cottage holdings, rights of common and by-industries in the homes, that was a necessary condition for the survival of the yeoman farmers until the great enclosure movement of the 18th and 19th centuries. Nevertheless, for harvesting, the open-field farmers were largely dependent upon town labour.

Enclosures and Industrial Development.—Enclosures, the development of the large arable farm, the introduction of new methods and the application of capital on a larger scale to farming, gave rise to the modern problem of adapting the work of a landless labouring class to the irregular demands of the new farming. At first, under the influence of the old poor law, an extreme and chronic casualisation of labour resulted. In the Eastern Counties the gang system developed, women and children were pressed into service to supplement the meagre earnings of

* Hasbach, "History of the English Agricultural Labourer," pp. 16-17.

the labourers, and Irish gangs became a regular feature at corn and potato harvest. The extension of factory industry, the greater mobility of labour, regulative legislation and the progress of the allotment and small holdings movements, have obliterated the worst features of the transition period. The extended use of machinery has brought within the scope of the regular farm hands such operations as the harvesting of corn, which in times past called for a great influx of temporary labour. In the classical 14th century example quoted by Lord Ernle,* upwards of 270 men were employed for two days in harvesting 250 acres of corn. Reaping and tying two acres provided a day's work for five men. To-day, a binder with one man and three horses and a man to help will cut and tie 8-10 acres in a day. In recent years, root-thinning and hop-picking machines are attacking two other persistent cases of casual employment.

On the other hand the use of the thrashing machine has destroyed the balancing winter occupation of regular farm workers in some districts, replacing it by bursts of casual labour. Indeed, the use of the flail in southern England persisted in the 19th century, partly perhaps on account of the difficulty of providing the labourer with other winter work.†

Present-Day Conditions.—At the present time the farmer must frame his policy within the limits set by his labour supply. The availability or absence of casual labour may be a factor determining the crops that can be grown and the acreage of each. If reliance is to be placed only on the regular farm hands, the most economical arrangement as far as manual labour is concerned, is that which, under average conditions, will ensure regular full-time employment for the men all the year round. The weather will always introduce an element of uncertainty, but, on the other hand, labour is flexible within the limits of overtime, and there is usually some work of a general kind such as hedging and ditching or some barn work to fill up slack time. The farmer's problem to-day is, however, widely different from that of the mediæval bailiff. The amount and character of the labour available from district to district and from time to time varies considerably. Labour is comparatively mobile, and factory industry offers an ever widening but fluctuating field of alternative employment. In particular the amount of casual labour that can be obtained will depend largely upon

* "English Farming, Past and Present," p. 11.
† Ditto, p. 369.

conditions of employment in other industries, and upon the outlet for the work of women and girls, especially where local industry demands the concentration of large numbers of comparatively unskilled labourers with their families. In so far as part-time employment in agriculture provides some subsidiary source of family income, that may be all to the good: so, too, if seasonal work on the land should dovetail with seasonal work in other industries it might be a positive advantage nationally as well as for the industries concerned, provided a regular interchange of suitably alternative occupations should result. Casual work on the farm is, however, generally of an unskilled character.* It is, moreover, irregular and spasmodic. It is in the main associated with certain crops which make sudden and short-period demands for labour. The seasonal labour requirements of stock and crops, and the character and distribution of the labour force required under different systems of farming become matters of some importance nationally from this standpoint.

Three Midland Farms.—An approach to this problem as it affects agriculture to-day is perhaps best made empirically by studying what happens in practice. For the purpose of an introductory survey of the problem the labour on three farms in the East Midland Area, worked on different systems as far as the cultivation of the arable land is concerned, and with varying proportions of crops and grass, has been recorded week by week and graphically represented as shown on the accompanying charts. In each case the work of a calendar year is shown. The base line is divided into 52 equal parts, each representing a week, and on each of these weekly divisions a vertical column has been built representing the number of hours worked by the farm hands during that week. The total labour in each week is divided by horizontal lines to show the number of hours worked on the several classes of live stock and on the different crops. The general order of arrangement has been to put the labour on the stock below, since in each case the dairy herd provides employment for a nucleus of labour, and to place the forage crops below the cereals and other selling-off crops. A further object has been to show those crops requiring casual labour above the others so that the connection between the crop, and any irregularities of employment may be clearly marked.

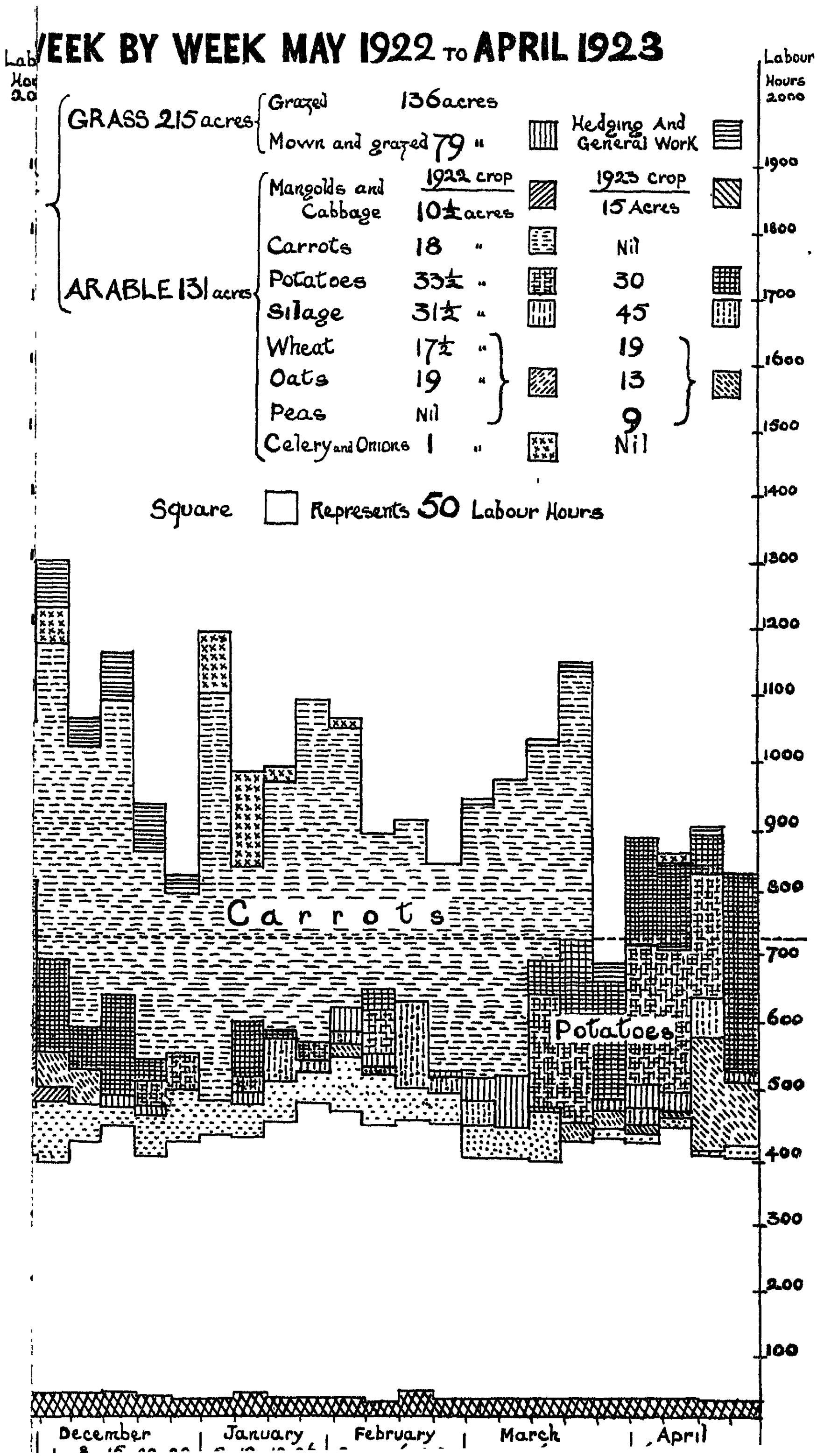
* The work of the relatively skilled craftsmen such as mechanics in charge of travelling thrashing sets, etc., and skilled hedgers, who ply a regular trade with different farms is not included in the term here.

Wherever possible the continuity of employment on the live stock or on crops over a period of weeks is also shown, though it could not be done in all cases. On each chart the acreage of the farm, its average or normal head of stock, the acreages under the several crops and the number of regular employees are recorded for the period covered. Across each a line is drawn at a level which represents the average number of hours worked per week by the regular hands. In arriving at this average, overtime has been included because it was not possible in all cases to distinguish between ordinary and overtime work where an inclusive wage was paid. It will be apparent that the hours actually worked by the regular employees during any week might be a little above or below that line. This straight line has been used in preference to an irregular line showing the actual hours worked week by week by the regular hands, to avoid complicating the charts unduly.

A graphical method of representation is employed as it offers certain advantages over a statement in figures. For showing the seasonal distribution of labour on individual crops it is best to start from a separate base line for each and plot the labour for a standard area of, say, 10 acres of crop. For representing all the labour *of the farm as a whole* it seems more convenient to combine the individual crop graphs in one, having regard to the numbers of stock actually carried, and the acreages worked.

Farm I: Abundant Casual Labour.—*Chart* 1 depicts a farm presenting several features distinguishing it from the others. The arable land is a light sandy loam suitable for intensive cropping, and the grassland is on adjacent heavy alluvial soil well provided with subsoil moisture. There is a good local market for fresh milk and market garden produce. Silage was grown on 31½ acres and the two tower silos received also the produce of 5 acres of oats and 25 acres of clover "seeds." In addition to corn crops and roots for feeding to cattle, 18 acres of carrots, 33½ acres of potatoes and 1 acre of celery and onions were grown.

The most striking feature of the labour on this farm is its extreme irregularity in total compared with the steady employment on the live stock. In nearly every week of the year some casual labour was employed. In June and July the hoeing and weeding of the carrot crop was in competition with potatoes, and the third week of July added the already competitive needs of the silage and hay crops. In August the weeding of the root and potato land clashed with the finishing of the silage. In September and October the comparatively large acreage of pota-



VEEK BY WEEK MAY 1922 TO APRIL 1923
Labour Hours 2000
GRASS 215 acres
Grazed 136 acres
Mown and grazed 79 "
Hedging And General Work
ARABLE 131 acres
1922 crop
1923 crop
Mangolds and Cabbage 10½ acres
15 Acres
Carrots 18 "
Nil
Potatoes 33½ "
30
Silage 31½ "
45
Wheat 17½ "
19
Oats 19 "
13
Peas Nil
9
Celery and Onions 1 "
Nil
Square Represents 50 Labour Hours
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
Carrots
Potatoes
December
January
February
March
April

toes required lifting and clamping before corn harvest was complete, and at a time when cultivations for next season's autumn-sown silage and wheat also demanded the attention of the regular hands. Over a period of four weeks in October the average hours worked were more than double the normal working week of the permanent hands. November found the working and sowing of corn and silage and the clamping of the roots in competition with the lifting of the carrot and market garden crops, whilst from December to March carrot sorting, bagging and delivery overshadowed the regular work on the land for the spring-sown crops, bad markets for both carrots and potatoes drawing out the period of disposal of both crops.

It will be apparent, without following out the operations in any further detail, that the labour requirements of this farm were successively dominated by the competition of hay and silage in the summer period, by the potato crop in the late autumn and by the carrots throughout the winter, this last crop adding also to the congestion of the summer work. The potato crop utilised during six weeks in September and October no less than 3,715 hours of labour, *i.e.*, 111 hours per acre during this short period. The carrot crop alone absorbed from 10th November, 1922, to 23rd March, 1923, 383 hours per acre, *i.e.*, an average of 363 hours per week on 18 acres, which was $1\frac{1}{2}$ times the total amount of regular labour available for work on the arable land during the same period. Crops of this character, which are bulky relatively to their value, and which require a good deal of hand labour for sorting and marketing within a limited time, exercise the greatest influence in proportion to their acreage upon the seasonal demand for labour. A substantial reduction of both crops would be called for on this farm in the absence of casual labour.

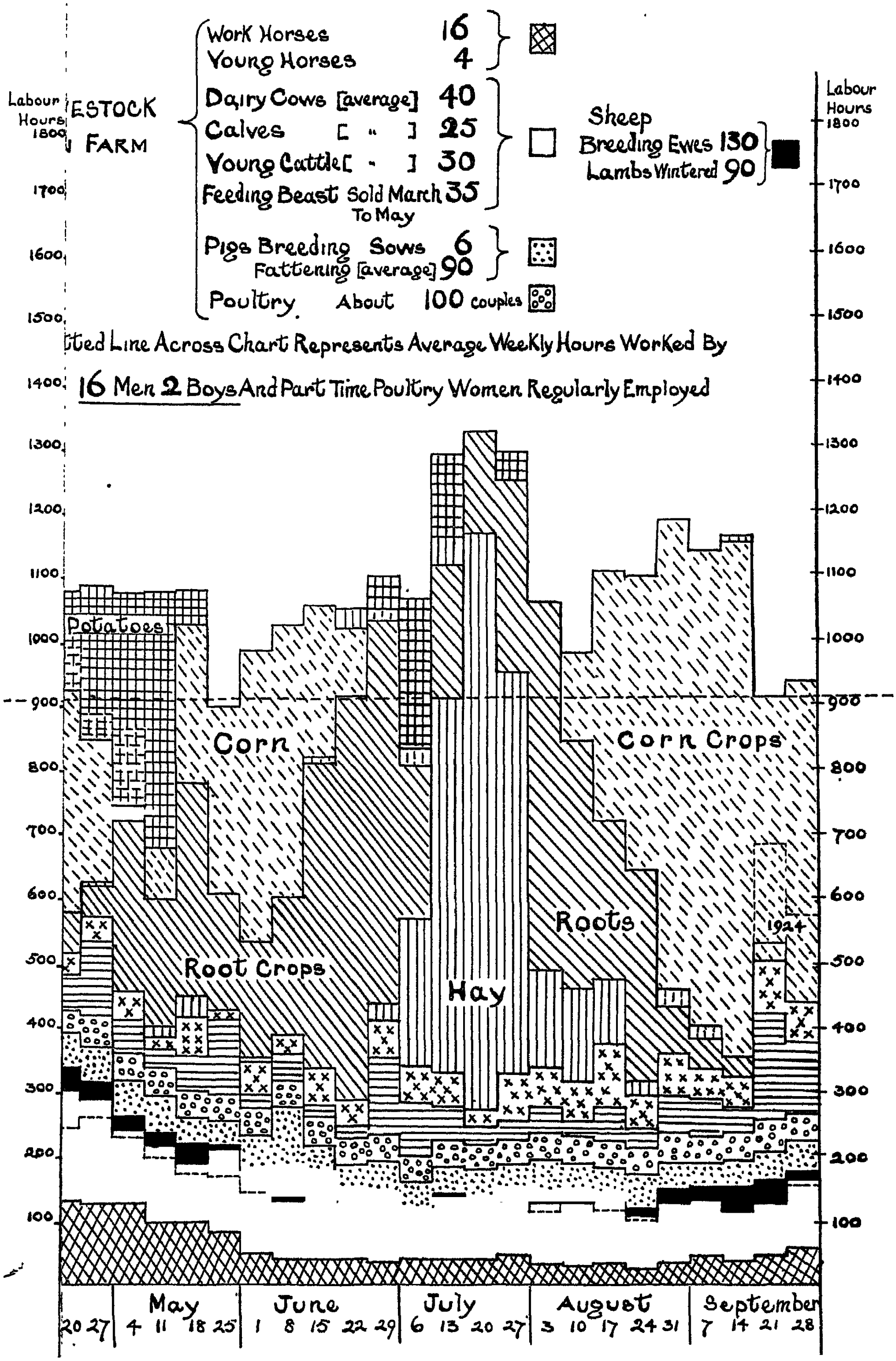
The cropping presupposed the availability of labour in the quantities and at the times required. The key to the situation lies in a remark of the farmer : " I have only to put up my hand in the village and I can get all the labour I want." The farm is situated within a few miles of a growing industrial town offering in normal times employment to a considerable number of relatively unskilled labourers, but very little outlet for female labour. During the period 1922-23 there was a good deal of unemployment in the area. From the beginning of May to the first week in July, two to four women or girls were needed for planting and hoeing onions, setting potatoes, hoeing carrots and potatoes, planting cabbage and celery, or pulling docks and

cutting thistles. For a week in June, nine additional men were weeding carrots or hoeing mangolds, the number being reduced to four in the following week. The mangolds and some ditching kept four or five men engaged until mid-July, when silage and hay gave them three or four days' work each week for a fortnight, and then full-time work for two more weeks. In the meantime one woman was kept on for weeding, to be reinforced by eight more men for a week on the carrot crop. This see-saw of inflated and diminished employment goes on, finding work more or less continuously for several months for one or two, and in a much larger number of cases providing a few days or weeks of discontinuous labour from time to time. The super-position of intensive arable cropping upon the basis of dairy farming rendered this inevitable. In the absence of casual labour the system would have been impossible.

Farm II: Little Casual Labour.—*Chart* 2 presents a marked contrast. The period covered was in this case from October, 1922, to September, 1923. Situated on the Keuper Marl with an admixture of overlying glacial sand, the soil is less suitable than that of the first farm for intensive cropping, and apart from a smaller acreage under potatoes and a little market gardening the arable farming was not of a specialised character. The farming is, however, fairly intensive, the arable exceeding the grass in acreage, whilst the dairy herd bulks less in the farming than in the previous case. The cows, sheep, pigs and poultry offer a steady and regular volume of employment, and the seasonal increase due to wintering fattening cattle is counterbalanced by the heavier summer and autumnal requirements of the arable land. The potatoes caused a heavy addition to labour in the form of a troop of schoolboys for lifting in the third week in October, but otherwise, except for a short period when the usual clash between hay harvest and root hoeing caused a peak in July and August, and some congestion at harvest, it might appear that there was little work that could not be overtaken by a spurt of overtime on the part of the regular farm hands. There was in fact some additional labour at the command of the bailiff, a steam thrashing set being owned by the farm, and the engine man lent a hand with the farm work when not engaged on thrashing.

One might, at first glance, be inclined to congratulate the management upon considerable foresight in planning the cropping. A closer scrutiny would, however, tend to modify that opinion. The various crops appear in turn to dominate the

EEK BY WEEK OCTOBER 1922 TO SEPTEMBER 1923



situation and the capacity of the regular farm workers is rarely exceeded. The lifting of the 1922 potatoes is followed by the lifting and eating off of the roots and the sowing of winter corn. Time is found for clearing up the old potatoes whilst attention is also given to the hedging and ditching, and the thrashing of the previous year's harvest dovetails in with the preparation of the ground for the spring-sown crops. These in turn monopolise the greater portion of the arable labour in March and April, but it will be observed that it is late in May before the potatoes are all planted, whilst the weeding of oats, barley and spring wheat is absorbing during June the labour required by the root land, and driving back the completion of hay harvest, already a fortnight behind the rest of the district. The sowing of 19 acres of spring wheat is itself an indication that work is badly behind. Congestion follows in the harvest time, and the combined labour of nine or ten men and two boys is unable to cope with the cutting and carrying without some outside help.

Thus the fairly even distribution of labour is seen to reflect a shortage of labour at times when speeding-up would have enabled work to be overtaken at the right time. The cropping, whatever the circumstances by which it was dictated, appears to call for a more flexible labour supply than was available. The farm is situated about four miles from a large commercial and industrial centre which absorbs a large volume of labour of all grades throughout the year. In the adjacent villages hosiery factories provide an outlet for the labour of women and girls. Under normal trade conditions there is very little surplus labour on which farmers in the locality can draw at times of pressure. One inference, at any rate, appears to be justified. In planning the season's work an omission to take into account the varied seasonal requirements of the stock and crops for labour, may result in grave difficulty in organisation and failure to carry out the programme in the absence of casual help that can be called upon in times of need. In the present case a heavy financial loss was experienced, to which poor yields and delays in marketing were factors of considerable importance.

Farm III: a Dairy Farm.—*Chart* 3 presents the simpler case of a dairy farm on which soil conditions eliminate the possibility of intensive arable cropping, and there is a preponderance of grass with a simple four-course rotation on the arable land. The irregularity of employment of the regular hands is emphasised by some casual help at root hoeing and singling in June and July, when the regular men were engaged on hay

harvest, and by a series of thrashings in September, October, December and February for which additional help was forthcoming from casual workers who followed the thrashing drum from farm to farm. Apart from these outstanding increases there is evidence of marked seasonal pressure, the summer months taxing the energies of the staff, whilst after corn harvest the greater requirements of the stock are insufficient to keep all the hands sufficiently occupied, in spite of attention to the hedges and general work about the farm. Indeed, on dairy farms on the heavier soils the want of labour-balance is often acutely felt. There is not sufficient difference between the requirements of the stock in summer and winter to occupy the time of the men freed from work on the arable unless stock for winter feeding is brought in to redress the balance.

Conclusions.—It is unwise to draw too many inferences from individual cases, but the three farms thus briefly studied will illustrate some of the difficulties of management of farms from the labour side. They are not exceptional cases. The records of a number of other farms of varying character all show considerable differences in the amount of time occupied from week to week, casual labour in some cases at busy seasons accounting for twice the time worked by the regular hands. One combination of stock and crops may at times be entirely beyond the working capacity of regular employees; another may involve periods of under-employment for the necessary nucleus of farm hands. On most farms there are limits set to variations in cropping and stocking policies by climate, soil, situation and equipment. The individual farmer has to balance the advantages of assistance in the form of men, horses and other equipment. Cropping which will utilise regular labour all the year round may involve an unsatisfactory balance of stock and crops, or production at a loss. Good farming policy is often the most satisfactory compromise between a number of conflicting ideals.

Socially, regularity of employment is desirable, and casual labour is often relatively expensive, so that the farmer's interest and that of the community are identical up to a point in arranging for as much work as possible to be done by regular and permanent employees. Since farming must be made to pay, however, the farmer can hardly be blamed if he avails himself of surplus labour to grow the more profitable crops.

If the labour supply is elastic, cropping can be arranged regardless of seasonal requirements and conditions will be favourable for the growing of crops such as potatoes and carrots. within the limits set by markets and the physical conditions.

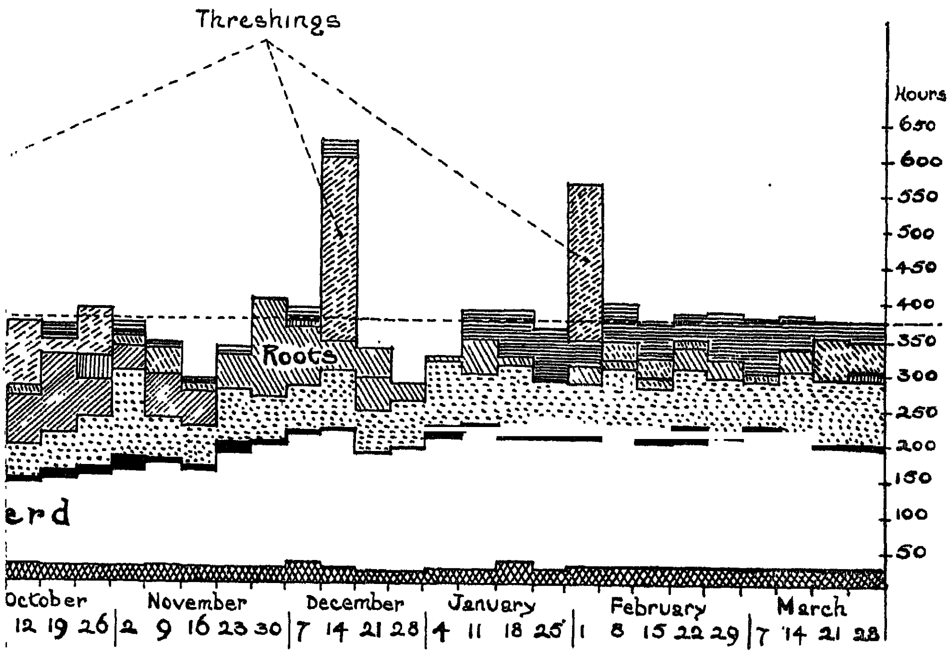
T 3

WEEK BY WEEK: APRIL 1923 TO MARCH 1924

LIVESTOCK ON FARM	Work Horses (including nag)	5	
	Dairy Cows (average)	31	
	Young Dairy Stock	33	
	Sheep (average)	40	
	Pigs Breeding Sows	9	
	Fattening (average)	90	

Dotted Line Across Chart Represents Average Weekly Hours

Worked By <u>6 Men And 1 Boy</u> Regularly Employed



of the farm. A more rigid labour supply reverses these conditions, and farm policy must be moulded within the limits set by the working capacity of the farmer and his regular men. This position arises to a greater or less degree with changes in the rate at which labour is paid, and an actual or effective labour shortage has to be met by a decrease in the intensiveness of cultivation, or the wider adoption of labour-saving devices.

It is perhaps characteristic of many kinds of farming that labour requirements are more or less spasmodic. Particularly has this been shown to be the case when specialised and intensive cropping is added to the activities of more general farming. A national policy aiming at the development of agriculture must take this into account if the interests of the agricultural labourer are to be identical with those of the farmer and consumer, and the temptation to any greater casualisation of labour in the greatest of our national industries is to be avoided.

* * * * * *

TRIALS OF SUB-SOILING, 1924.

THE following article has been contributed by the Institute of Agricultural Engineering, Oxford:—

In the winter of 1923 and the spring of 1924 the Ministry in co-operation with the East Anglian Institute of Agriculture, Chelmsford, sub-soiled a series of plots in Essex upon which it is proposed to take observations for five years. Further plots were laid down in Oxfordshire during 1924. Upon the formation of the Institute of Agricultural Engineering at Oxford in April, 1924, the conduct of these experiments was transferred to the Institute. The general methods of sub-soiling were detailed in an article which appeared in this *Journal* for January, 1923, p. 911. The results obtained from the first year's experiments were published in this *Journal* for February, 1924, p. 1000. These showed that each sub-soiled plot produced a greater yield than the plots which had been ploughed only, and that in every case the increase repaid the extra cost of sub-soiling.

The investigations now assume a two-fold character. It is desired in the first place to discover the number of years during which the beneficial effects produced by sub-soiling will last, and also to determine the reasons which cause the increased fertility.

Essex Trials.—In Essex during 1923 potatoes of Kerr's Pink, King Edward and King George varieties were grown, on two fields of sand and gravel, and on a field of boulder clay; wheat was grown on London clay, and barley on brick earth. In 1924

wheat, and spring and winter barley, were grown on the fields which previously grew potatoes; winter oats succeeded the barley grown on the brick earth field; and peas ultimately followed the wheat grown on London clay. On the last-named field clover and trifolium were originally sown with the wheat, but after the wheat had been harvested only a moderate crop of clover and trifolium was obtained from the sub-soiled plots, and scarcely a plant grew on the plots which had been ploughed only. As a consequence the part of the field that had not been sub-soiled and a portion of the sub-soiled part were ploughed up and peas were sown.

Since the plots in Essex were sub-soiled over two years ago they have not again been sub-soiled. Each field (including both sub-soiled and control plots) has received identical treatment in the matter of cultivation, manure and seeds.

The results given in the accompanying tables show that each sub-soiled plot has again produced an increased yield over the plots in the same field which were ploughed only.

It is not, of course, possible to make a direct comparison between the results of the first and second years; it is nevertheless desirable to draw attention to certain interesting features which the results reveal. Thus on brick earth, barley has responded in approximately the same measure as the crop of oats grown last year. Wheat following potatoes on boulder clay, shows a substantially lower percentage of increase, but is nevertheless about equal to the yield of a crop of wheat grown on London clay last year. Barley following potatoes on sand and gravel shows a general increase in yield.

Recent observations on the various plots showed that the disturbed sub-soil has not consolidated, and consequently it may be expected that the results of the first and second years may be repeated to some degree.

Oxford Trials.—The Oxford experimental plots were established in the spring of 1924 on fields of stone brash and Oxford clay. The swede crop grown on the stone brash was at an early stage, it was severely attacked by turnip fly, which killed out all plants on many patches in the field, whilst the plants which survived were greatly retarded. Although the actual yields from the sub-soiled and control plots have been collected, the results are of no value for comparative purposes and are not included in the following tables. On Oxford clay tares and oats, intended for ensilage, were grown. The results show that sub-soiling to depths of 5 in. and 7 in. had the effect of increasing the yield by 31.2 per cent. and 29 per cent. respectively.

It is desirable to explain that the value of the crops contained in the accompanying tables is, with one exception, the actual price obtained when the produce was sold. The exception is that of the tares and oats which were grown for ensilage, and in this case the value has been taken at 25s. a ton. While it is convenient to state increased returns in terms of money, it will of course be borne in mind that these must vary with wages and prices. The only criterion of permanent value is the increased yield in terms of crop expressed as an average over a series of years for different types of land.

Laboratory work is proceeding hand in hand with these field experiments in order to discover the reasons for the increased fertility already demonstrated. When these are more advanced it is hoped that it will become possible to state the precise soil conditions which will be bettered by sub-soiling, and also to prescribe the best mechanical means for producing the required results.

YIELD AND VALUES PER ACRE.

TABLE I.

SAND AND GRAVEL (FIELD I).

Control Plots.

Year.	Crop.	Depth of Ploughing.	Yield.		Value.
			Ware or Grain.	Chats or Straw.	
		In.	lb.	lb.	£ s. d.
1923	Potatoes—				
	Kerr's Pink ...	5	9,363	1,624	24 8 9
	King Edward ...	5	12.521	2,284	28 7 5
1924	Spring Barley ...	5	2,054	1,911	14 18 9

Sub-soiled Plots.

Year.	Crop	Depth of Sub-soil-ing.	Difference in Yield.		Gain per Acre.		
					Weight.		Value.
			Ware or Grain.	Chats or Straw.	Ware or Grain	Chats or Straw	
		In.	lb.	lb.	per cent.	per cent	£ s. d.
1923	Potatoes—						
	Kerr's Pink	5	6.025	315	64.33	19.44	15 1 6
	King Edward	5	7.033	112	56.1	4.9	20 10 2
1924	Spring Barley	*	873	1,224	42.5	64.0	6 17 11
1923	Potatoes—						
	Kerr's Pink	7	3,337	11	35.64	– 0.69	8 3 9
	King Edward	7	4,547	414	36 3	–18.1	12 16 6
1924	Spring Barley	*	880	1,274	42.8	66.7	7 0 1
1923	Potatoes—						
	Kerr's Pink	9	593	593	6.34	–35.17	19 6
	King Edward	9	1.176	313	9.3	–13.7	3 2 8
1924	Spring Barley	*	886	1,351	43.1	70.7	7 2 11

* Not sub-soiled since 1923.

TABLE II.

SAND AND GRAVEL (FIELD II).

Control Plots.

Year.	Crop.	Depth of Ploughing.	Yield.		Value.
			Ware or Grain.	Chats or Straw.	
		In.	lb.	lb.	£ s. d.
1923	Potatoes—				
	Kerr's Pink ...	5	16,016	3,584	42 10 6
	King Edward...	5	15,120	2,867	46 8 8
1924	Winter Barley ...	5	1,423	1,527	10 12 5

Sub-soiled Plots.

Year.	Crop.	Depth of Sub-soil-ing.	Difference in Yield.		Gain per Acre.		
					Weight.		Value.
			Ware or Grain.	Chats or Straw.	Ware or Grain.	Chats or Straw.	
		In.	lb.	lb.	per cent.	per cent.	£ s. d.
1923	Potatoes—						
	Kerr's Pink	5	4,995	112	31.19	3.12	12 7 3
	King Edward	5	2,307	806	15.2	28.1	7 8 4
1924	Winter Barley	*	436	474	30.6	31.0	3 5 1
1923	Potatoes—						
	Kerr's Pink	7	8,355	—560	52.16	15.62	20 0 3
	King Edward	7	9,699	134	64.1	4.6	28 5 4
1924	Winter Barley	*	441	483	31.0	31.6	3 7 0
1923	Potatoes—						
	Kerr's Pink	9	6,496	—313	40.56	—6.2	15 15 0
	King Edward	9	3,763	22	24.8	0.78	10 18 0
1924	Winter Barley	*	474	428	33.3	28.0	3 8 6

* Not sub-soiled since 1923.

TABLE III.

BRICK EARTH.

Control Plots.

Year.	Crop.	Depth of Ploughing	Yield.		Value.
			Grain.	Straw.	
		in.	lb.	lb.	£ s. d.
1923	Barley	5	1,174	—†	4 14 4
1924	Oats	5	2,254	2,957	13 16 0

† The straw was not weighed in 1923.

Sub-soiled Plots.

Year.	Crop.	Depth of Sub-soil-ing.	Difference in Yield. Grain.	Difference in Yield. Straw.	Gain per Acre. Weight. Grain.	Gain per Acre. Weight. Straw.	Gain per Acre. Value. £	s.	d.
		In.	lb.	lb.	per cent.	per cent.	£	s.	d.
1923	Barley ...	5	220	†	18.7	—	—	17	8
1924	Oats ...	*	528	792	23.4	26.8	3	7	6
1923	Barley ...	7	244	†	20.8	—	—	19	8
1924	Oats ...	*	719	1,090	31.9	36.9	4	12	3
1923	Barley ...	9	348	†	29.6	—	1	8	0
1924	Oats ...	*	586	1,144	25.9	38.7	4	2	0

* Not sub-soiled since 1923.

† The straw was not weighed in 1923.

TABLE IV.

BOULDER CLAY.

Control Plots.

Year.	Crop.	Depth of Ploughing.	Yield. Ware or Grain.	Yield. Chats or Straw.	Value. £	s.	d.
		In.	lb.	lb.	£	s.	d.
1923	Potatoes—						
	Kerr's Pink ...	5	4,054	1,075	10	18	3
	King George ...	5	5,241	806	13	11	9
1924	Wheat	5	1,505	2,287	11	6	11

Sub-soiled Plots.

Year.	Crop.	Depth of Sub-soil-ing.	Difference in Yield. Ware or Grain.	Difference in Yield. Chats or Straw.	Gain per Acre. Weight. Ware or Grain.	Gain per Acre. Weight. Chats or Straw.	Gain per Acre. Value. £	s.	d.
		In.	lb.	lb.	per cent.	per cent.	£	s.	d.
1923	Potatoes—								
	Kerr's Pink	5	2,396	—141	59.11	—13.12	5	15	2
	King George	5	3,046	156	58.12	19.44	7	12	5
1924	Wheat ...	*	336	168	22.3	7.3	2	1	6
1923	Potatoes—								
	Kerr's Pink	7	2,195	—232	54.14	—21.66	5	3	7
	King George	7	2,889	320	55.12	39.72	7	7	8
1924	Wheat ...	*	561	776	37.3	33.9	4	2	7
1923	Potatoes—								
	Kerr's Pink	9	2,038	—15	50.27	—1.45	4	19	10
	King George	9	2,912	268	55.55	33 "3	7	7	10
1924	Wheat ...	*	373	485	24.7	21.2	2	14	1

* Not sub-soiled since 1923.

TABLE V.

LONDON CLAY.

Control Plot.

Year.	Crop.	Depth of Ploughing.	Yield.		Yield.
			Grain.	Straw.	
		In.	lb.	lb.	£ s. d
1923	Wheat	5	2,751	*	12 5 5
1924	Peas	5	2,155	2,180	19 18 8

Sub-soiled Plot.

Year.	Crop.	Depth of Sub-soiling.	Difference in Yield.		Gain per Acre.		
					Weight.		Value.
			Grain.	Straw.	Grain.	Straw.	
		In.	lb.	lb.	per cent.	per cent.	£ s. d.
1923	Wheat	7	722	*	26.2	*	3 4 5
1924	Peas	†	387	170	17.9	7.8	3 4 8

* The weight of straw was not measured in 1923.
† Not sub-soiled since 1923.

TABLE VI.

OXFORD CLAY.

Control Plots.

Year.	Crop.	Depth of Ploughing.	Cost of Ploughing.	Yield.	Value.
1924	Tares and Oats (ensilage)	In. 5	s. d. 15 6 (Horses)	lb. 16,312	£ s. d. 9 2 0

Sub-soiled Plots.

Year.	Crop.	Depth of Sub-soiling.	Extra cost of Sub-soiling.	Difference in Yield.	Gain per Acre.	
					Weight.	Value.
1924	Tares and Oats (ensilage)	In. 5	s. d. 34 3 (Horses)	lb. 5,033	per cent. 31.2	£ s. d. 2 16 8
1924	Tares and Oats (ensilage)	7	20 4 (Tractor)	4,736	29.0	2 12 10

ADVANTAGES OF MILK RECORDING.

The advantages to be derived from keeping accurate records of the milk yields of cows have been urged repeatedly for many years, but such advantages are not yet as fully appreciated or as readily recognised as they might be, and although the Milk Recording Scheme of the Ministry has now been in existence for ten years there is still considerable apathy on the part of the British dairy farmer. Before the inauguration of this scheme in 1914 as part of the general scheme for the improvement of the live stock of the country, milk recording in England was mainly confined to the owners of pedigree herds and to agricultural colleges and other educational institutions. During the last ten years, however, the movement has grown continuously and very considerable progress has been made. At the same time it must be admitted that the work is still in its infancy and that there is ample scope for extension of the practice. The number of cows and heifers in milk or in calf in England and Wales is, in round figures, 2,615,000 and of these only about 115,000, *i.e.*, less than 5 per cent. are being officially recorded.

In Denmark and other countries a thorough investigation has been made into the question of cost in the production of milk and its products, and it is now recognised that the taking of accurate records of milk yield, of individual butter fat tests and the examination of rations form the basis of any such investigation with a view to determine where cost may be reduced and production economically increased.

Selection of Good Milkers.—The first lesson to be learnt from the practice of keeping milk records is that of *Selection*. Economy in production is in the first instance attained by selecting the right animals, viz., those giving a high yield of milk, provided they are of sound constitution. Every farmer is aware that there are good and bad milkers, differing comparatively little in their cost for keep and attendance, yet varying in milk yield from 400 to 1,000 gallons in a lactation period. The low-yielding cows in the herd certainly do not pay for their keep. These mere "pensioners" on the farm should obviously be fattened and sold, but first they must be identified, and the only sure means of identifying them is to keep records. Some cows give

a large daily yield of milk for a short period only after calving, while others give moderate daily yields over a long lactation period, and it is impossible to estimate accurately the total yields of either class by mere observation. Even some of the most experienced judges of dairy stock have erred in calculations by as much as 200 gallons in their estimates of the yield of individual cows. Only by weighing the milk daily or weekly can the milk yield of each cow be ascertained. The record provides exact figures as to the producing power of each, thus indicating which should be disposed of and which retained. The following is a striking example of the great difference which exists between herds in their milk-producing value. Two members of the same milk recording society had 42 cows each. All were recorded for the full year. The average yield of the 42 cows in one herd was 889 gallons; that of the other was 372 gallons. The approximate difference in the total yield was 21,700 gallons, which at 1s. per gallon represents a difference of £1,085 in the gross receipts for the same number of cows.

Breeding.—Having discovered the right cows to keep, the next problem to solve is the grading up of the herd. This can be done by rearing one's own heifer calves from the best milkers that have been sired by a bull of good pedigree milking strain, and always keeping in view the fact that good conformation and constitution are essential for success. Milk records form the starting point for choosing the cows whose calves it will pay to rear, and even if the farmer does not rear his own heifer calves he will find that those from officially recorded dams will command higher prices than those which have no records behind them.

Rationing.—The keeping of milk records also forms the necessary basis for the scientific rationing of cows from the point of view of economical production of milk. When it is borne in mind that the cost of feeding cows, taken all the year round, accounts for probably no less than two-thirds of the total cost of milk production, the importance of this subject can hardly be over-estimated.

The first principle of economical feeding of dairy cows is to ascertain, by carefully kept records, how much milk each cow is giving, and to regulate the quantity and nature of her food accordingly.

Education.—Apart altogether from financial considerations, the work of milk recording is interesting and educational to the farmer and his employees. By a study of the records any slight

reduction in yield will be noticed and the cause can be investigated. If the cause is sickness, improper feeding, exposure or neglect, the necessity of a remedy is brought immediately to the owner's attention. One of the first symptoms of ill-health in a cow is a decrease in the yield of milk, this often appearing before outward signs are visible, and a serious illness can thus often be checked in time. Milk recording should encourage more efficient milking and more careful feeding, and where the owner is a member of a milk recording society he becomes associated with the progressive dairy farmers of his district, for their common benefit and good fellowship, and for friendly rivalry, besides getting into touch with some of the scientific problems which are continually arising in the practice of farming.

Private Recording.—There are, of course, farmers who prefer to record privately rather than officially, and their records are no less accurate on that account. These farmers certainly have all the particulars they require for their own information, but their records do not possess the same commercial value when they wish to sell dairy stock or its progeny. Purchasers, and especially those from abroad, naturally show a marked preference for officially checked records, rather than for privately kept records, the acceptance of which usually depends on personal knowledge and appreciation of the herd-owner.

Again there are some farmers recording privately who maintain that their records are sufficient for the reason that they do not rear calves. Such owners are usually overlooking the possibility that one of their cows may prove to be of outstanding merit, a regular breeder and a consistent " thousand-galloner." Calves from such a cow would clearly be worth rearing to sell at the greatly enhanced value which they would acquire from the official milk record of their dam.

Expense of Recording.—Another type of herd-owner refrains from recording on the ground of expense. Such expense in the case of a herd of 20 cows belonging to a member of a typical milk recording society is as follows :—(1) An annual subscription of, say, £1 1s., irrespective of the size of his herd, and (2) a yearly levy at the rate of, say, 4s. per cow; total £5 1s., or less than 1¼d. per week per cow. In return for this modest outlay he reaps the following substantial benefits :—

(1) The records of his entire herd are checked in a thoroughly reliable manner which ensures that they will be generally accepted as statements of fact.

(2) Cows and their progeny vary in value in proportion to their records, and prices of deep-milking stock with authenticated records are likely to remain firmer than those of non-recorded stock.

(3) He is provided with a reliable guide as regards the elimination of unsatisfactory animals and the selection of animals from which to breed, and a most useful index to the health of his cows and the efficiency of his feeding system.

(4) His cows are marked and registered for permanent record (and his calves also, if he so desires, at a nominal cost).

(5) All the necessary books, forms, etc., are provided without cost to himself. Beyond his subscription and levy he has no further liability, except for purely optional subsidiary services such as butter-fat tests, special visits, etc.

The following instance of the marked advance in the average yield of individual herds as a direct result of the more systematic and economic management arising from the adoption of milk recording is of interest: In the returns for 33 of the herds (of over 20 cows) of a certain society recording under the Ministry's milk recording scheme, which were recorded from 1917-18 to 1922-23, there was an average increase in the yield per cow of full-year cows of 92 gallons. The maximum increase shown by a herd was 234 gallons per cow, namely, from 524 to 758 gallons.

The dairy farmer must constantly be studying the problem as to how the cost of production can be reduced, and the herd managed if he is to make his business a paying proposition. The solution of the problem can be assisted by pursuing a policy of careful selection, breeding and scientific feeding; in other words, by successful management, the key to which is undoubtedly the keeping of milk records.

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FRUIT PACKING IN ONTARIO.

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THE Province of Ontario, though three and a half times the size of the British Isles, has a population of but little over two and a half millions, and one might make the mistake of making a mental picture of a vast country sparsely populated. In the average this, of course, is correct, yet inasmuch as the largest

portion of the Province--Northern Ontario—still awaits settlement and contains relatively but a few people, the smaller portion is well developed with populous towns and well-peopled countrysides, far more so than many parts of the Mother Country. It is in this populous area that the Ontario fruit industry exists, and amidst these surroundings the fruit-growers have framed their existing practices of marketing, which seem well adapted to meet the conditions.

The Ontario fruit industry is an important one, more so for producing fruit for home consumption than for export, and for that reason, though less known to merchants in Great Britain, it ranks the highest in Canada. The Province is said to produce 60 per cent. of the apples and cherries, 69 per cent. of the plums, 84 per cent. of the pears, 92 per cent. of the peaches, and 98 per cent. of the grapes grown in Canada, which fairly gives a measure of its importance in fruit production. The apples are produced over an area stretching from Lake Ontario in the west to Lake Huron in the east, and from Lake Erie in the south to Georgian Bay in the north.

The Niagara Fruit District.—Crops of other kinds of fruit, together with some apples, are concentrated into a narrow stretch of land lying between the western hills and Lake Ontario, and extending from Hamilton to Niagara. This area of the Niagara peninsula is regarded as the garden of Canada. The soil is naturally of a silty nature, though varying very considerably in texture, so that patches of very light, medium and heavy soils occur quite frequently, and each is cropped in its special way. Orchards of standard peach trees abound on the light soils; pears, plums and apples on the medium, whilst numerous acreages of the heavy soils are planted to grapes—white, red and black. Fields of strawberries, raspberries and currants are common. Market gardening is also largely practised in selected districts, where specialisation in certain types of crops is the practice—in the Niagara district tomatoes and asparagus, in Leamington onions, etc. The Niagara peninsula district, lying well down south, has a climate coming under the moderating influences of the Great Lakes, so that the day and the night temperatures are more even, and spring frosts very rare. All these factors combined, are said to give high flavour and piquancy to Ontario-grown fruit and to render the production of a good annual crop a fairly sure thing.

The area contains good roads and a splendid system of railway transport, so that there is little difficulty in linking up the pro-

ducing centres with the numerous and populous towns which abound in the vicinity. There is the large town of Toronto close by with three-quarters of a million people, and numerous other large towns like Hamilton, London, Chatham and Windsor near at hand; whilst over the border in the United States of America, there are Detroit, Buffalo and a whole number of other industrial centres all requiring fresh fruit daily. In other words, the environment of the Ontario fruit industry is not very dissimilar from that of Great Britain; a point of some importance when one comes to compare the methods of marketing practised by each.

The trees in the orchards follow the English system and are planted close together: but in culture, cover cropping, manuring with artificials, and spraying to control pests, the methods adopted are very similar to those in Nova Scotia, an account of which was given in this *Journal* for December, 1924, p. 856.

Only the yellow-fleshed varieties of peaches are grown, of which the St. John, Early Crawford and the Elberta are the most important. No particular care is observed in packing this fruit for market, and it gets no better treatment than the apple. Best samples, good enough for dessert, are put in 12-quart covered chip baskets; whilst seconds and thirds are bundled into basket containers made of chip wood.

Plums grow well in the Niagara peninsula, and trees of such varieties as the Burbank, Climax, Yellow Gage, Grand Duke, Reine Claude and Monarch, this season bore much bigger crops than could be disposed of in the markets, and many hundreds of bushels remained ungathered. In marketing, the 12-quart chip basket is almost invariably used. In construction, it follows the form so common in England, but differs in having a skeleton chip cover, the centre of which is a linen network made in colours of pink, green, blue or red. The blue net is used for blue plums, green for the gages, and pink for peaches and pink plums. The coloured network certainly adds to the appearance of the basket, making the fruit appear more highly coloured, and permits the inspection of the fruit without disturbance of the baskets.

Bartlett pears (Williams' Bon Chrêtien) are widely grown for dessert purposes and for canning. This crop is popular, but severe losses from Fire Blight are common. These also are marketed in chip baskets.

Apple Packing.—Of apples, the Snow, Spies, McIntosh, Wealthy, Baldwin and Greening are the most important. The fruit is well grown on the commercial fruit farms, but, as in

England, there are numerous farm orchards where the trees are left to produce fruit without any particular care. Hence, samples of Ontario apples vary greatly. This fruit is disposed of in many ways and finds its way into several different kinds of packages. At times apples are loaded loose into railway vans and sent to the western prairie towns, but, fortunately, such a disastrous practice is not common. Much is sold in open bushel chip baskets, unsorted and ungraded and loosely packed, though the Fruit Act requires that the surface layer must give a true representation of the bulk. Best samples of dessert varieties are marketed in 12-quart chip baskets, and the popularity of these small packages is certainly increasing. Apple boxes are used by some, but the standard package for Ontario apples is the large three-bushel barrel with flat hoops. It is a nice package, readily packed and easily rolled from place to place, but it contains too much fruit to suit all markets.

The box and the barrel, being closed packages, can only be used for packing fruit which has been sorted and graded in accordance with the standards defined in the Fruit Act, and so the law has more or less compelled growers to practise methods of grading and packing and to look upon these operations as a preliminary step in the marketing scheme. Generally, the growers have worked on individualistic lines by establishing small packing stations on their farms, or by adopting packing in the orchards by such improved methods as can be quickly and easily established. In orchard packing the girls and men work in groups in the orchard, sizing and grading the fruit by hand and eye, and carrying out most of the operations commonly done in the fruit-packing house, without much machinery aid. Orchard packing is the system common to Ontario: it is a cheap system entailing no overhead charges, and in that sense is attractive, but it is a little doubtful whether by such a system a common level grade can be established over a wide area.

In addition, the individual shipper system is common, which means that merchants in the producing districts purchase "orchard run" fruit by direct purchase from growers, and carry out the grading and packing either in the orchard or in their own small private packing houses.

Co-operative Packing and Marketing.—By such means the bulk of the Ontario fruit is graded, packed and marketed, and yet, in addition, co-operative marketing has made a commencement. Several small societies exist for the selling of district fruit, and in the case of the Niagara peninsula a determined

effort has been made to set up a central selling agency—the Niagara Peninsula Growers' Association—which may, in time, become a really great movement.

The Niagara Peninsula Growers' Association was started as a central selling agency for about 800 individual growers, and during the recent period of low prices has been considerably re-organised. It still has, nominally, 800 members, though a far smaller number now use its offices for selling produce. Good foundations have been laid, and, stage by stage, a really sound marketing association is being established. Most of the members pack their own fruit in the orchard, as already stated, but in one or two instances local associations have been started with small packing houses in which communal packing is practised. The communal packing house system is still in the infancy stage in Ontario.

Proximity to Markets.—The methods used in dealing with the Ontario apple crop are very similar to those in the home country, and one can only conclude that the surroundings in which a producing industry is placed and the ease with which marketing can be effected influence the methods of packing and marketing in a most striking way. Ease of marketing appears to foster a spirit of individualism amongst producers, so that each develops his own particular line or fancy without reference to his fellow growers, and without standardisation of methods and practices on communal lines.

This proximity to the markets with its consequent ease of marketing has not secured for the Ontario fruit grower a complete monopoly even of his own markets, for it is customary to find in the fruit stores, boxes of well-packed apples from British Columbia and even boxes of grapes and plums from as far away as California. Coming such long distances, these boxes of fruit suffer severe financial handicaps, and can only compete and secure a sale when the methods of grading and packing and the size of the container make a direct appeal to the fruit distributors. As on the English markets, the long-distance packages are competing and causing the local growers to scrutinise the local methods, and developments of the packing-house method in Ontario are expected in the near future.

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COUNCIL OF AGRICULTURE FOR ENGLAND.

THE fourteenth meeting of the Council was held on 11th December, 1924, at the Middlesex Guildhall, Westminster, Mr. George Edwards being in the Chair.

Appointments to the Agricultural Advisory Committee for England and Wales.—At separate meetings of the Minister's members and of the County and Borough Agricultural Committee's members, Mr. J. R. Spraggon, Sir Douglas Newton, M.P., Mr. Robert Hobbs and Professor T. B. Wood, were re-elected, and Colonel Courthope, M.P., was elected to the Agricultural Advisory Committee.

Lord Ailwyn's Death.—The Chairman referred to the serious loss which the Council and Agriculture generally had sustained through the death of Lord Ailwyn of Honingham, and the Council, standing, passed a vote of sympathy and condolence with Lady Ailwyn and family.

Statement by the Minister of Agriculture.—Mr. Edward Wood said that it was a pleasure to address the Council for the first time, in a rather more hopeful atmosphere as regards agricultural prospects. The world consumption of wheat appeared to be increasing, and agricultural bankruptcies in this country in the first nine months of this year had considerably diminished. He counted himself very fortunate in having Lord Bledisloe as Parliamentary Secretary to collaborate with him in his work. The first step which the Government had taken was, as the Council no doubt knew, to invite a conference composed of representatives of the three sections of the industry, the landowners, the farmers, and the landworkers. He noticed that the Standing Committee had tabled a proposal for an almost identical conference or committee. The first need was to arrive at an agricultural policy which would meet with general acceptance, at any rate, within the industry itself. The Minister then discussed the general scope of inquiry which would be open to the conference. He also mentioned the conditions of the ten-year subsidy which was to be granted in respect of the Sugar Beet industry. He hoped that the Merchandise Marks Bill which the Government proposed to proceed with might be able to be treated as a non-controversial proposal. As to Tithe, the 1918 Act expires at the end of 1925, and a new Bill appeared to be necessary. The Government proposed to continue the Agricultural Rates Act. The assistance which was being given by the State in respect of the development of rural industries would be increased. He would like to see a Sub-Committee of the County Agricultural Committee

functioning in every county, and keeping in touch with the Rural Industries Bureau and the Women's Institute. The Minister then referred briefly to the usefulness of County Agricultural Committees, and to the desirability of all of them appointing representatives to this Council. He said he had never been able to see the functions of this Council in any way conflicting with the objects, or still less the interests, of the various organisations in the agricultural industry, whether the Land Owners' Association, or the Farmers' Union, or the Agricultural Workers' Union. He had read with pleasure in the December issue of the "National Farmers' Union Record" a statement that appeared to imply that there was a good prospect of the recent misunderstanding with the National Farmers' Union as to the functions of the Council being cleared up and removed. He thought it would be deplorable if the members of a great representative agricultural body such as the National Farmers' Union felt unable to take part in the deliberations of this Council, and he hoped that the Farmers' Union would ask their members to do all that they could to facilitate the appointment by County Committees of representatives upon this Council, as it was imperative for agriculture to present a united front. As regards wages, the new Act had started under favourable auspices. Over 40 of the local Committees out of 47 had so far appointed Chairmen by agreement without reference to him. Speaking of foot-and-mouth disease, the Minister emphasised the importance of farmers themselves reporting cases of disease with the utmost speed, as the success of the preventive and remedial measures depended entirely upon their immediate application. In conclusion, he said he did not think it wise to underestimate and depreciate what may be the aggregate effect of small, steady and consistent reforms and improvements in agriculture, and while he held his present office he would look to carry along with him the great body of agricultural opinion. He hoped he could count upon the assistance and advice of the Council, which he would always warmly welcome.

Lord Clinton, in moving a vote of thanks to the Minister, said he saw no reason why the conference of representatives of landowners, tenants, and workers, which had been called should not find many points of agreement in considering what should be the basis of our National Agricultural Policy. Of the points which had been agreed at a previous conference of the three intersts only one part had been put into effect.

Mr. Denton Woodhead seconded the vote and referred to the satisfaction the return of those members of the National Farmers'

Union who had withdrawn would give to the Council; and with regard to the proposed conference, commented upon the representation of workers upon it, which he said was insufficient.

Mr. Donaldson and *Alderman Davis* also spoke to the motion, which was carried unanimously.

Statement as to Previous Resolutions.—*Sir Francis Floud K.C.B.*, on behalf of the Ministry, made a report as to the action taken by the Ministry on the resolutions passed at the last meeting of the Council. The items were as follows :—

(*a*) *Allotments.*—(Mr. Forbes' Resolution); matter coming before Allotments Advisory Committee on 17th December.

(*b*) *Land Drainage.*—(Mr. Spraggon's Resolution); the question of increased powers for County Councils was being considered with the County Council's Association with a view to an agreed Bill being introduced.

(*c*) *Quorum of the Council.*—(Sir Douglas Newton's Resolution); regulations had been made by the Minister to give effect to the Resolution for reducing the quorum.

(*d*) *Compulsory Weighing of Fat Cattle.*—(Mr. Donaldson's Resolution) a Bill was being drafted and would be introduced at an early date.

(*e*) *Holding Company's Returns.*—(Mr. Ashby's Resolution); the Board of Trade had under consideration the question of whether legislation should be introduced.

(*f*) *Rural Industries.*—(Mr. Ashby's Resolution); the Minister was strongly in favour of Rural Industries Sub-Committee of County Agricultural Committees being set up afresh where they had ceased to function, and the grants to the Rural Industries Bureau were being maintained.

(*g*) *Land Reclamation and Unemployment.*—(Mr. Hawk's Resolution); Mr. Hawk had been informed that if schemes could be proposed for Cornwall or any other counties where land drainage was not practicable, to deal with reclamation as a means of giving employment to workers who are out of work, the Ministry would be prepared to consider them; no such schemes had so far been submitted.

(*h*) *Agricultural Rating.*—(Mr. R. L. Walker's Resolution); the matter was almost certain to come up for consideration by the proposed conference, and in any case was not one in which the Ministry alone could do anything. The Government would no doubt consider it with reference to the conference.

Agricultural Policy.—*The Rt. Hon. F. D. Acland*, Chairman of the Standing Committee of the Council, moved that the Report

of the Committee on the question of a suggested Committee on Agricultural Policy should be received for the purposes of record. The recent proposal by the Minister for a conference had superseded the recommendations in the Report. *Mr. Dallas* referred to the difference between the recommendations in the Report and the Minister's proposal so far as the representation of labour was concerned. In the Report, the representation of labour had been equal to that of the landowners and tenants together, both considered as employers of labour. *Captain Morris, Mr. Bilsland, Mr. Owen Webb*, and *Mr. Spraggon* spoke to the motion, which was put to the Council and agreed.

Unemployment Insurance.—The Chairman of the Standing Committee (*Mr. Acland*) moved the adoption of the Report on the subject of Unemployment Insurance for Agricultural Workers as follows :—

> "The Committee having examined the question of Unemployment Insurance for agricultural workers is of opinion that sufficient data are not yet available upon which to found an equitable scheme.
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> They accordingly recommend that before any scheme be framed inquiry should be conducted to ascertain the number of persons in permanent and casual employment, respectively, in Agriculture, and the incidence of unemployment in each class, with a view to the question being reported upon by a Departmental Committee at a later date."

Mr. Acland enumerated the difficulties that the Standing Committee found to be in the way of the construction of a satisfactory scheme of Unemployment Insurance for Agricultural Workers. He was followed by *Mr. Dallas, Mr. H. W. Thomas, Mr. Spraggon, Lord Bledisloe, Mr. Woodhead, Sir Merrik Burrell*, and *the Chairman*. *Lord Bledisloe* informed the Council on behalf of the Ministry that a Departmental Committee would be set up in accordance with the Standing Committee's recommendation. *Sir Merrik Burrell* pointed out the danger to the worker if the wages fund of the farm were unduly depleted by payments for Insurance. It would undoubtedly tend to casualise some of the labour which is at present permanent. *The Chairman* pointed out that that tendency already existed when bad times occurred, and urged that some scheme of insurance, not an expensive one, was required.

Land Drainage and Millers' Rights.—The Chairman of the Standing Committee (*Mr. Acland*) next moved the acceptance of the Report on Land Drainage which had to some extent been covered in the statement by Sir Francis Floud. The question as to millers' rights and obligations had been raised by the Buckinghamshire County Council, as stated in the Report. *Mr. Dobson*, on behalf of the Ministry, said on the question

of millers' rights that the Land Drainage Act of 1861 clearly laid it down that a Drainage Board had power to deal with such rights, and mill-dams, weirs, and other obstructions by agreement. In the event of no agreement being arrived at the Board had the power to appeal to Petty Sessions for the right to remove the obstructions. In Herefordshire a Drainage Board had by agreement moved very serious obstructions without resorting to the appeal to Petty Sessions for compulsory powers.

Agricultural Education and Research.—The Chairman of the Standing Committee (*Mr. Acland*) moved that the Report of the Standing Committee on Agricultural Education and Research should be received. He drew attention to the fact that the Committee wished to emphasise the need for special attention to be given to animal disease research, particularly in regard to tuberculosis; also to the importance of the development of new varieties of the principal crops by seed breeding, and to the spread of any new knowledge of crops as quickly as possible and to the multiplication of the supplies of seeds and plants of new varieties before they are distributed. The Report also advocated that the teachers in country schools should receive special agricultural training in vacation classes or otherwise to fit them for their duties. Further recommendations in regard to agricultural engineering, live stock development, farm institutes and agricultural discussion societies were also mentioned.

Sir Daniel Hall, on behalf of the Ministry, said with regard to animal disease research that large sums of money had recently been devoted to the improvement of the organisation in this respect. The Royal Veterinary College had been enabled to build a Research Laboratory at Camden Town, and a new Research Institute is being built at Cambridge. A special Institute had been organised at the School of Hygiene in London for the study of diseases caused by parasitic organisms. Three Advisory Officers have been appointed to establish more local contact and local investigation in connection with animal disease research. In view of the fact that new research workers had to be trained, he thought that we were now going as fast in that direction as was safe.

As regards the introduction of new varieties of our crops, steps were being taken towards more systematic and accurate testing schemes for all varieties of farm crops. New varieties would be shown more widely to farmers as soon as their value could be established. The Council should, however, remember that the initiative for the direct instruction of farmers was in the hands of the County Education Committees, or of the County

Agricultural Committees. Unless these authorities took the initiative, the Ministry was rather powerless in attempts at the direct education of farmers. As to obtaining closer touch between County Organisers and Advisory Officers, that was a matter which the Ministry had very much at heart. The Advisory Officers represented a comparatively new service and were not as much known as they ought to be amongst farmers. Provincial meetings between County Organisers and Advisory Officers were being arranged. As regards Farm Institutes, it was probably best to wait a little before setting up more. No words which Mr. Acland could say were too good for the beneficial effect that the Ministry had noted as arising from the discussion societies holiday courses for teachers in rural districts.

Lady Mabel Smith said she hoped soon to bring before the Ministry a scheme which would, amongst other things, provide training courses for teachers in rural districts.

Mr. Donaldson, Sir Merrik Burrell, and *Mr. Hawk* spoke in regard to the Report, the motion to receive which was then passed by the Council.

Animal Nutrition Research.—The Chairman of the Standing Committee (*Mr. Acland*) moved that the Report from the Standing Committee on the subject of facilities for Animal Nutrition Research in Great Britain should be received. This Report was the outcome of a resolution by the Council at a previous meeting, which had resulted in a joint report by Professor T. B. Wood, Director of the Institute at Cambridge, and Mr. Orr, of the Aberdeen Institute. It was generally to the effect that further provision should be made to maintain adequately the research in question. *Mr. Dallas* inquired whether financial difficulties any longer really existed in regard to the subject.

Sir Daniel Hall replied that they had been removed through the grant of the late Government of a further £500,000 for agricultural education and research.

Conditions of Casual Employment.—*Lady Mabel Smith* moved the adoption of the Report from the Standing Committee with regard to seasonal employment on the land, particularly of women and children. The Report was as follows :—

> "The Standing Committee has considered the Reports which are circulated herewith; and it recommends to the Council that they be received, and that the Ministry be urged to take what action it deems dersirable, in the light of the Reports and otherwise, for the improvement of the conditions of the employment of women and child labour on the land, without delay."

It was necessary that some action should be taken to improve the conditions of casual employments of women and children

before next season. This could be done if the Ministry would urge the Ministry of Health or the Local Authorities to take the requisite steps to put suitable regulations into force. The figures of employment in the hop industry in Kent in 1914 showed that there were 43,000 women workers. Lady Mabel Smith drew attention also to the report of the Medical Officer of Health for Kent upon health conditions among the hop-pickers. The Report was accepted by the Council.

Agricultural Co-operation.—*The Rt. Hon. F. D. Acland* moved :—

> "That the Council recommends all farmers to take a practical interest in the agricultural co-operative movement. This interest can be shown by :—
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> (*a*) supporting the National Farmers' Union, which has now decided to set up a special department in regard to its activities in promoting agricultural co-operation;
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> (*b*) bringing to the notice of the local branches of the National Farmers' Union cases where conditions with regard to purchase of requirements or sale and distribution of produce are detrimental to the producers' interest and where combined action might improve these conditions;
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> (*c*) supporting loyally any farmers' co-operative society set up to improve these conditions;
>
> (*d*) taking a live interest in the working of any such society and insisting that the principles of good business management shall be observed, including competent staff, sound finance, and adequate inspection, and federation for joint purchase or sale with other similar societies."

Mr. Woodhead seconded the motion, to which *Mr. Patterson*, *Major Hotchkin*, and *Captain Morris* spoke. The motion was put to the meeting and carried.

Fertilisers and Feeding Stuffs Act Committee's Report.—*Sir Merrik Burrell* moved :—

> "That the Ministry be asked to press forward the necessary legislation to give effect to the Fertilisers and Feeding Stuffs Act Committee's Report."

The motion was duly seconded, and *the Minister*, in speaking to the motion, said that he associated himself with what Sir Merrik Burrell had said as to the debt under which all agriculturists laboured to Lord Clinton and his Committee for the valuable work in their Report. The Ministry had under consideration, and had made good progress with, a draft Bill designed to give effect to it. An Advisory Committee was even now being set up to assist in the preparation of the schedules to the Bill and in other relative matters. He hoped it would be possible to proceed with the Bill in the forthcoming Session of Parliament.

Lime for Agricultural Purposes.—*Mr. Hamilton* moved:—

> "That the Council welcomes the proposal of the Ministry of Agriculture to facilitate the acquisition of supplies of lime for agricultural purposes, and suggests that the Ministry be asked to make a Report as to the adequacy and suitability of the existing sources of supply for agricultural purposes, and the possibilities of extending them."

Mr. T. Lovell seconded the motion, which was supported by *Mr. H. W. Thomas. Sir Daniel Hall* addressed the Council on the subject and said that it was hardly necessary, perhaps, at the moment to press the inquiry which Mr. Hamilton had suggested, as the Ministry was informed by firms who manufactured lime or limestone that they can supply very much more than is demanded from them. The resolution was put and agreed.

Agricultural Advisory Committee's Reports.—*Lord Strachie* moved:—

> "That the Reports of the Agricultural Advisory Committee and of the Standing Committee have precedence on the Agenda of the Council Meetings of all other motions."

The resolution was duly seconded and spoken to by *Mr. Dallas, Mr. Acland,* and *Lord Clinton.* It was agreed to refer the resolution to the Standing Committee.

Wheat Growing.—*Mr. H. W. Thomas* moved:—

> "That in the National interest something should be done to encourage the production of wheat in this country."

Captain Morris seconded the resolution, which was spoken to by *Mr. Dallas, Alderman Davis,* and *the Chairman.* It was pointed out that the subject of the motion would naturally come before the conference, and the mover, by leave of the Council, withdrew the resolution.

Report of Agricultural Advisory Committee.—*Mr. Dallas* moved that the Report (No. 8) on the Proceedings of the Agricultural Advisory Committee for England and Wales should be received. *Mr. Rea* seconded the motion and commented upon the fact that it was deplorable that cases of foot-and-mouth disease should be allowed to go unreported, thereby causing serious spreads of the infection. The fines in some instances inflicted by local Benches were merely nominal. The Ministry differentiated between England and Scotland in their restrictions, and a good deal of ill-feeling was thus created. *Lord Bledisloe* stated that the Ministry had been in communication with the Home Office on the question of fines; and, in regard to the restrictions in Scotland and England, a difference had been made because Scotland had been more fortunate than England in regard to the incidence of the disease. Mr. Rea's representation would, however, receive sympathetic consideration. The Report was then received.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

THE following is the half-yearly report (No. 8) to the Councils of Agriculture for England and Wales on the proceedings of the Agricultural Advisory Committee:—

The Agricultural Advisory Committee has held three meetings since the date of its last report to the Councils, viz., on 4th June, 2nd July, and 6th August. The subjects which were under consideration at these meetings were as follows:—

(1) **Foot-and-Mouth Disease.**—The Committee has had before it at each meeting reports upon the position at the time. The Committee does not think it necessary here to go into details of these reports, and it will probably be sufficient to say that they show on the whole that there has been a considerable improvement. It was unsatisfactory to the Committee to learn, however, that outbreaks had come to light which had been allowed by those on whose premises they occurred to go unreported for some days—in one case for probably as long as a month. The Committee understood that legal proceedings would be taken in all possible cases for non-report, but it cannot forbear to comment upon the very unfortunate circumstance that certain farmers or cattle-owners should allow the disease to exist unreported on their premises at a time when immediate reporting is absolutely vital to its swift eradication from the country.

At the meeting on the 2nd July, the Committee agreed that the markets of Scotland, and of as large a part of England as the Ministry thought safe, should be opened to Irish stores, on the ground that it was much better business for a farmer to buy in a market than to have to trust to selection by an agent at the port of landing, and also on the ground that all restrictions put upon trade as a consequence of foot-and-mouth disease should be removed as soon as it appeared safe to do so.

Difficulty was reported by the Ministry through the regulations which certain County Authorities had made in order to protect animals in their own counties from possible infection by contact with animals brought into them. In some cases the Ministry had had to set aside County regulations, as they are empowered to do. The Committee on more than one occasion has considered the general aspect of this matter and has come to the conclusion that as the Ministry has power to veto local

regulations governing the movement of animals it should exercise that power whenever it considers such a course desirable in the general interest.

Special consideration was given to the outbreaks which had emanated from sewage farms and abattoirs, and also to the question of the need for a general Standstill Order. The Ministry undertook to consider whether any measures were possible to disinfect sewage and offals from abattoirs, and, in regard to the Standstill Order, expressed itself of opinion that in view of the exceptions which would have to be made for fat stock and for occupation movements, the effectiveness of such an Order would be so much reduced that it would not be worth while to cause the great disturbance to the industry that would be involved.

(2) **County Agricultural Committees.**—At the meeting on the 4th June, the Minister submitted a draft letter which had been prepared for sending to the County Agricultural Committees embodying certain suggestions which, if adopted, were in his opinion calculated to assist their general usefulness in the counties. It was suggested that the Committees should, in addition to their existing functions, assist agricultural education and research by the dissemination of the results of research, the encouragement of farmers to pay visits to the large Research Institutions, and in other ways. It was suggested also that the Committees might give attention to the question of the better marketing of agricultural produce, both as regards co-operative organisation and transport development, and where necessary might undertake a survey of the agricultural conditions in their counties. Additional funds would be available to meet the additional expenses which would be incurred by the Committees. The Advisory Committee discussed the proposal and expressed general agreement with it.

(3) **Economic Experiments in Systems of Farming.**—The Committee at their meeting on 4th June, considered also a scheme to assist the testing of new systems of farm management. The main proposal was that selected farmers should be paid comparatively small sums to induce them to try new plans of farming under supervision, or to keep and supply for publication, accounts of plans which they are already trying. It was expected that about 40 farms in England and Wales would be used for this part of the scheme and that the maximum annual charge would be about £4,000. Larger experiments in which

it would be necessary to guarantee to a farmer a reasonable return for adopting a new and prescribed method, but which would be applied to not more than 12 farms, were expected to cost about £10,000 a year. The administration of the scheme was to be put in the hands of the Institute for Research in Rural Economics at Oxford. The Committee considered that the experiments suggested were likely to be of considerable use to agriculture, and it approved the proposal.

(4) **Farm Institutes, Carmarthen and East Sussex.**—Amended proposals were submitted to the Committee for a Farm Institute for Carmarthen, which had originally been suggested in 1919, but not proceeded with on account of national economy. The Committee agreed that the establishment of this Institute might proceed.

In regard to the Farm Institute for East Sussex, it was agreed at the meeting on the 6th August that some further inquiries should be made and the proposal brought to the Committee again.

(5) **Fertilisers and Feeding Stuffs Act Committee's Report.**—The Advisory Committee, having considered this report, passed a resolution expressing approval of it and adding that legislation to give it force should be put forward at the earliest possible moment.

(6) **Additional Funds for Agricultural Education and Research.**—It was reported to the Committee at the meeting on the 6th August that an additional sum of £500,000 had been obtained to assist the development of agricultural education and research during the next five years. A statement of the proposed general allocation of the money was circulated to the Committee, which agreed with it. The money would be advanced through the Development Fund in the same way as the £850,000, and would be available both for England and Wales and Scotland. No definite allocation between the two parts of Great Britain was to be adopted. The main items of the proposed expenditure were:—Foot-and-mouth disease research; economic research (testing new systems of farm management); marketing investigations, etc.; veterinary education and research; advisory scheme (for completion of existing advisory scheme); soil surveys; additional research grants; vegetable testing; and National Institute of Agricultural Botany.

(7) **Importation of Animals.**—It was reported to the Committee at their meeting on the 6th August that the preparation of the Bill to give effect to the understanding arrived at at the Imperial Economic Conference in regard to the importation of animals was going forward. The Bill would be introduced in the Autumn Session.

(8) **Broadcasting Agricultural Information.**—It was reported to the Committee that an arrangement had been made with the British Broadcasting Company, to broadcast a short agricultural talk every fortnight, commencing at the beginning of October. A few facts about markets and points of immediate agricultural interest would be given, as well as a statement on any special matter which the Ministry desired to bring before agriculturists at the time.

(9) **Application of Lime.**—It was proposed to institute a scheme by which farmers moving co-operatively could obtain assistance in liming their land. The Chief Scientific Adviser to the Ministry considered that lime was badly needed in many parts of the country. The proposal was that where farmers formed a society and gathered in enough members to put up a comparatively large order, *e.g.*, between 300 and 500 tons, the Ministry would entertain proposals for a loan for the purchase and delivery of the lime to the farmers' respective stations. The Ministry would require to see that a good contract was made, that the lime was bought wholesale, and that transport was arranged as cheaply as possible. As to repayment of the loan, it was suggested that the borrower should repay at the rate of the cost of half a ton of lime per acre per annum. The scheme with one or two suggested improvements was approved by the Committee (24th September, 1924).

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THE FOX.

PROFESSOR J. ARTHUR THOMSON, M.A., LL.D.,
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SINCE the last wolf was killed in Britain (about 1743), the only native representative of the dog tribe of carnivores has been the fox. A very fine representative it is, with its handsome variable coat, usually reddish-brown above and white below; with its tapering muzzle which suggests inquisitiveness; with its large black-backed triangular ears that indicate alertness; and with its bushy tail which may be half the length of the almost

yard-long body. We may have strong convictions as to the relations between the fox and poultry, but there is no denying that the fox is one of the handsomest of wild animals. The dog fox is rather larger and handsomer than his mate.

Habits.—The fox (*Canis vulpes*) is a solitary, for the sexes live separately, except at the pairing time, and the hunting is always on the " each for himself " plan. Sometimes a natural hole or a badger's burrow is used as a retreat; usually the fox digs an " earth " for itself. Most of the hunting goes on in the gloaming, or under cover of darkness, or in the early morning; and thus the fox is not such a familiar animal as one would expect from its numbers. It often lurks unsuspected in tangled woods that people pass every day. Long distances may be covered in a night and great daring and ingenuity may be shown in getting at coveted booty. It is said that a speed of twenty miles an hour may be reached when the fox is hotly pursued, and there are many stories of foxes baffling the hounds by finding some unexpected refuge—even below the surface of a stream. There is no doubt as to the alertness of its senses and the nimbleness of its wits. It is not for nothing that the fox is second cousin to the dog.

Food.—The length of the fox's bill of fare is also noteworthy, for it is always easier for a creature to survive when it can make many different kinds of meals. A fox will eat rabbits and rats, chickens and ducks, pheasants and partridges, lambs and leverets, field-voles and water-voles, grouse from the moor, frogs from the marsh, and crabs from the sea-shore. Cases are known of foxes condescending to eat insects, but this is little more than a curiosity, like a man eating locusts.

Teeth.—The fox's teeth are, of course, the same as a dog's: three incisors, one canine, four premolars, and two molars in the upper jaw, and an additional molar in the lower jaw. To the last premolar above and the first molar below the special name " carnassial " or " sectorial " is applied, for they have a particularly sharp cutting blade, well-suited for snapping slender pieces of skeleton, or severing tendons, or getting the last shreds of flesh off a big bone.

Scent-Gland.—Like many other carnivores, the fox has a scent-gland beneath its tail, from which there comes a slightly greasy secretion with an odour disagreeable not only to man, but to some wild mammals as well. It probably helps the fox to recognise the vicinity or the track of its kindred, but there is evidence that the animal may occasionally behave like the

skunk and use the repulsive substance to induce its enemies to pass by on the other side.

Feigning Death.—Another remarkable habit is that of "feigning death," when the fox lies unmoving and awry after it has been struck, but uses its first opportunity to make a sudden bolt for freedom. In lower animals this assumption of immobility usually means a sort of catalepsy; in the fox, however, it may be in part a deliberate ruse.

Family Affairs.—Foxes breed in winter, and the males sometimes fight savagely for a desired mate. A quaint detail is the sudden flicking of the brush in a rival's eyes. The gestation lasts about two months, and the blind cubs—four to as many as seven of them—are born at the end of March or the beginning of April. From the time of birth to soon after the opening of the eyes they have a uniform sooty colour; this changes into tawny above and smoke-grey below; much later they begin to look like their parents.

The cubs are suckled for a month, and then they are fed for a while on rats and voles and other tender things. The vixen is indefatigable and intrepid in finding food for her family. She has been seen hurrying home with half-a-dozen field-voles in her mouth—an agricultural fact of considerable interest.

Like many other carnivore mothers, she teaches her offspring, who remain with her till September, playful and delightful creatures. Both the schooling and the playing greatly increase their chances of success in their subsequent struggle for existence, but eventually the vixen cuts the apron-strings, and the young ones are driven off to fend for themselves. They go off on separate paths, Ishmaelites from the start, and seek for unoccupied territory. They are not full-grown till eighteen months old. The playfulness we have just mentioned is sometimes turned to direct use. For a fox, like a stoat, will sometimes gambol in an extraordinary manner (chasing its own tail for instance) in the presence of rabbits, who stand by like interested and amazed spectators until the clown suddenly makes a snap at a throat and the comedy ends in a tragedy!

Indictment of the Fox.—(1) There is no evading the charge that foxes kill lambs, especially on hill-farms. The remains have been found at the den, and the circumstantial evidence is convincing. Moreover, like some other carnivores, the fox sometimes "runs amok" and kills more lambs than he can possibly use. We take this to mean that when the killing instinct gets agoing, *and the stimulus persists*, there is no stopping the urge.

And we should remember what an extraordinary experience it must be for a wild carnivore to come on a field with a hundred young lambs! There is nothing like that in any natural environment—not even among wild sheep.

(2) The fox has been called "the nightly robber of the fold," but perhaps the "fold" oftenest visited is the poultry-yard. From a detached natural history point of view the depredations of Reynard the Fox on chickens, ducklings, goslings and the like are often of great interest, they show such cleverness. But the poultry-keeper cannot be expected to take this point of view! The loss is often serious, though it tends to diminish with modern improvements in hen-houses and the like. Perhaps the fox deserves some credit as an unconscious agent in the evolution of these improvements. One suspects, moreover, that the vanishing fox is sometimes a convenient scapegoat. But there is no getting past the remains of victims found at the den.

(3) The third charge is that the fox levies a heavy toll on birds that nest on the ground, such as pheasants, partridges and grouse. This also must be admitted, and it is readily intelligible that in places where "game" birds are important, *e.g.*, on high moorland, the number of foxes must be strictly controlled. There are curious circles in these inter-relations of living creatures: the more foxes the fewer pheasants, one may say, but it is just as true that the more pheasants (or pheasant-preservers) the fewer foxes there will be.

(4) The fourth charge involves greater difficulty. It is that in fox-hunting counties foxes are preserved to an extent that is prejudicial to agricultural interests, and that the hunt itself does considerable damage to cultivated land. In most cases, however, compensation is made to farmers for damage that can be traced to either of these causes. The question of fox-hunting in itself is outside science, but the probability is that if fox-hunting stopped there would soon be no foxes. Just as turkeys have persisted because man has thrown over them the shield of domestication—for the wild turkey seemed, till recently, a doomed bird—so foxes survive in a highly cultivated country because they are hunted!

What is to be Said for the Fox.—The list of British mammals is a short one, and it would be a loss to the general interest of the country if the fox disappeared. It cannot, indeed, be ranked, like its second cousin the wolf, as a wild animal dangerous to the lieges, but there is no doubt that it does a considerable amount of harm—little, however, compared with that done

by rats. The question arises whether there is much to be said for the fox except that it is an interesting and handsome animal, and that it affords good sport. The answer is that the fox helps to preserve a wholesome Balance of Nature—for it keeps a check on the multiplication of rabbits, rats, mice, and voles. We have already referred to the number of field-voles that the untiring vixen catches for her cubs. That alone should cover a multitude of depredations.

Our compromise conclusion is that the multiplication of foxes should be controlled. This is usually effected by means of baited traps. Sometimes an artificial burrow is arranged for the vixen at the breeding season, so that the cubs may be dug out at the proper time and transported to a fox-hunting county. It is possible that the difference between the smaller "terrier foxes" of the lowlands and the larger "greyhound foxes" of mountainous regions is due to the sterner struggle for existence in the uplands and northern parts. The survivors are finer specimens than those seen in areas where foxes are "preserved" and hunted! But it may be that there are also racial differences; and it must be remembered that large numbers of foxes have been introduced into England from the Continent.

We cannot leave the fox without recalling that it has been a native of Britain since Upper Pliocene times, and that it has survived in spite of heavy odds, the most serious of all being the destruction of the great forests where it originally found shelter. it has survived because of its swiftness, its alertness, its burrowing and nocturnal habits, the maternal care, and the education of the young. But part of its success is the reward of sheer cleverness. The fox kills its own scent, plays 'possum and escapes at the last moment, makes a trap go off without being caught, and drifts down a river like an old potato sack until it is safe to land. We cannot wonder that Bacon advised statesmen to study the fox!

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SILVER-LEAF DISEASE OF FRUIT TREES.

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PLUM and apple trees growing in fruit plantations and in private gardens frequently produce foliage of a silvery colour in contrast with the dark green hue of healthy leaves. This change in the foliage represents the beginning of one of the most serious diseases of fruit trees in this country.

Cause of the Disease.—Silver-leaf disease, as it is called, is caused by a fungus, *Stereum purpureum*, which commonly grows on tree stumps. The fungus usually appears after heavy rain as a number of purplish brackets, projecting about half an inch from the stump and densely superimposed one over the other. These bodies are the fruiting portions of the fungus, and give rise to myriads of exceedingly minute spores which, like seeds of ordinary plants, serve to propagate it. The spores are discharged into the air, and, being of miscroscopic size, are readily blown about. If these spores happen to alight on a wound in a plum tree, they will germinate there and give rise to a spawn which grows into the interior of the tree, spreading both upwards and downwards. The silvery foliage is an early and indirect symptom of the presence of the fungus in the wood below, but in the course of time the fungus spreads to such an extent that the branches begin to die back and ultimately the tree is killed. As the tree dies, the spawn of the fungus grows out to the surface of the bark and there produces large numbers of the purplish fruit bodies which serve as a source of infection for other fruit trees in the vicinity.

It is only in recent years that serious investigations into the causes of plant diseases have been made. A generation or so ago these troubles were almost universally looked upon as being due to the visitations of a malign Providence or to the blasting effects of certain types of weather. It is now known, however, that plant diseases, like human diseases, are caused by the invasion of parasites or through some other disturbance in the normal life of the organism. Before the cause of silver-leaf disease was understood, its serious nature was generally ignored in the large fruit-growing districts of the country, with the result that large plantations of Victoria and Czar plums were virtually wiped out by it.

Control.—Now that the cause of this disease is known, measures can be taken to stay its ravages. With fungus diseases of plants it is rarely possible to attack the parasite directly: its effect is at first so insidious that the disease is usually well established before outward signs of its presence are visible. Again, there is nothing in plants comparable with the blood stream of man, so that treatment by medical means is generally out of the question. Preventive measures of an indirect nature can, however, be taken which reduce the incidence of silver-leaf disease to a minimum. It is clear that if the fungus causing this disease could be destroyed completely,

the disease would not occur. Unfortunately the fungus is too widespread to be annihilated, although it can be greatly reduced in quantity through destruction by fire of any woody material in gardens and fruit plantations likely to harbour it. By such measures of plant sanitation the infective capacity of the fungus can be greatly reduced. To be effective, such a measure must be of universal application, hence the Ministry has been empowered by legislation to ensure that all trees and branches killed by silver-leaf disease, and therefore liable to produce fruit bodies of the fungus, are burnt. Fruit growers now recognise that one of the chief means of preventing the spread of this disease is by the abolition of the sources of infection from within their own plantations.

The spores of this fungus cannot invade the tree through uninjured bark, but only by way of some exposure of the wood. Every effort should therefore be made to prevent the formation of wounds. With Victoria plums the branches should be supported in some way when heavy crops render them liable to rupture. Pruning should be reduced to a minimum compatible with other requirements. The aim of the fruit grower should be so to shape the trees when young that they require little or no cutting out when mature. Where large wounds do arise they should be covered with soft grafting wax or thick paint to prevent invasion by the fungus.

Resistant Varieties of Fruit.—Some varieties of fruit trees are much more liable to silver-leaf disease than are others. Unhappily, two of the best varieties of plums as regards quality and cropping capacity, namely, Victoria and Czar, are particularly susceptible to this trouble. Other varieties, such as Early Rivers, Pershore, Greengage, Purple Egg, and Monarch are attacked comparatively rarely. In general, apples are less liable to the disease than are plums, but there are a few varieties such as Early Victoria and Newton Wonder that are sometimes particularly prone to it. Pear trees are almost completely immune, and sweet cherries are rarely attacked. On the other hand, Morello cherries and peaches may be considerably affected. In small gardens laburnum trees often succumb to it, chiefly on account of the drastic pruning to which they are often subjected.

The fate of a tree affected by silver-leaf disease is usually death within a year or two, although even Victoria plums occasionally recover complete health and vigour in the course of

time. It must be remembered that whenever a plant or animal is invaded by a parasite, a continual struggle is waged between the two organisms, and although in silver-leaf disease the fungus usually gets the upper hand, this does not invariably happen. Plum trees which are growing vigorously are more likely to throw off silver-leaf disease than trees in a week state. Vigour in such trees is dependent upon them growing in a suitable soil and being provided with a well-developed root system to absorb the food substances necessary for active growth. The root system depends chiefly upon the type of stock used for budding or grafting, and upon good cultivation in the nursery. Suitability of soil is an essential factor in successful fruit-growing, plums liking best a loam of good quality containing a sufficiency of lime. As long as fruit trees can be maintained in active growth through good cultivation, including the addition of manure where necessary, there will be a considerable amount of natural recovery from this disease. In view of this possibility of recovery silvered fruit trees should not be destroyed until they begin to die back.

As intensive cultivation extends, the danger from disease tends to increase, but by taking the common-sense measures of plant sanitation and by growing the crops under the most suitable soil conditions, the losses from disease can be kept within bounds, and in the case of some diseases can be reduced to negligible proportions.

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TURKEY REARING IN NORFOLK.

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Ministry of Agriculture and Fisheries.

Losses in Turkey Rearing.—Reports have come to hand from all parts of the country of severe losses sustained by turkey rearers both in the early part of the season and in mid-season (August). Unfortunately the information was in most cases too late for any close investigation, and the details available are frequently too meagre to enable any satisfactory conclusion to be reached as to the probable causes.

Very little definite information is available about turkey diseases in this country. "Blackhead" is known to be one of the worst evils, but we are almost entirely dependent upon the work carried out in America for information upon this disease. The diagnosis by owners is not necessarily reliable and it is probable that much of the loss attributed to blackhead

may be due to other causes. Only laboratory examination can definitely settle this in many cases, although from ordinary post-mortem examination blackhead can frequently be identified. The source of infection by this disease is puzzling turkey breeders. It is believed by some owners that this and *Coccidiosis* disease are one and the same; they occur at the same season of the year and at similar stages in the growth of the young stock. Owing to the similarity in the symptoms, however, the cause of loss may frequently be wrongly diagnosed by the layman; this view is perhaps strengthened by the fact that the use of catechu has been effective in checking loss in suspected outbreaks of blackhead.

Unfortunately it is not widely known amongst turkey breeders that facilities are now offered them for obtaining a diagnosis in cases of disease by the submission of specimens to the Ministry's Veterinary Laboratory. On the other hand, in some of the instances which have come to notice the breeder has failed to take advantage of the preliminary advice given him to send a specimen to the Laboratory for examination. This is most unfortunate, and it cannot be expected that rapid progress will be made in the knowledge of turkey diseases until the breeders assist the research worker by furnishing all the information and material required. Only by bringing their troubles to the proper quarter can they expect the help which is so badly needed.

Swelled head is another troublesome disease of which the origin is not known, and although less disastrous in effect than blackhead it is very prevalent and is responsible for considerable loss to turkey rearers.

Measures for the prevention of the spread of these diseases or for the effective treatment of affected flocks cannot be assured until more is known of them, although from such work as has already been done treatment can be suggested which in some cases has given satisfactory results.

In some parts of the country more than others "gapes" takes considerable toll amongst the young turkeys. Although the source of infection is sometimes hard to trace, preventives and remedies are better known. Many losses are also traceable to body parasites for the presence of which the breeder is himself frequently to blame because of his neglect, and since it is not known how far these pests may be responsible for the spread of other diseases, this is a source of trouble against which turkey rearers should take every precaution to guard them-

FIG. 1.—A Breeding Flock under ideal conditions.

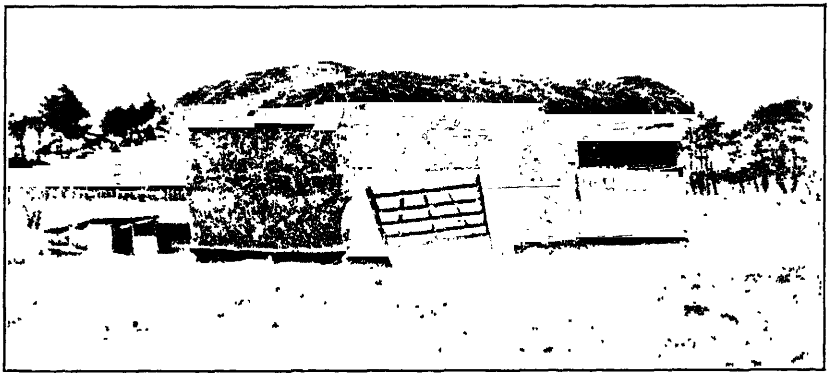

FIG. 2.—Turkey Shelter on the Ministry's Estate at Methwold. The frame is constructed of fir poles, the walls of bracken packed between wire netting, with straw on the roof.

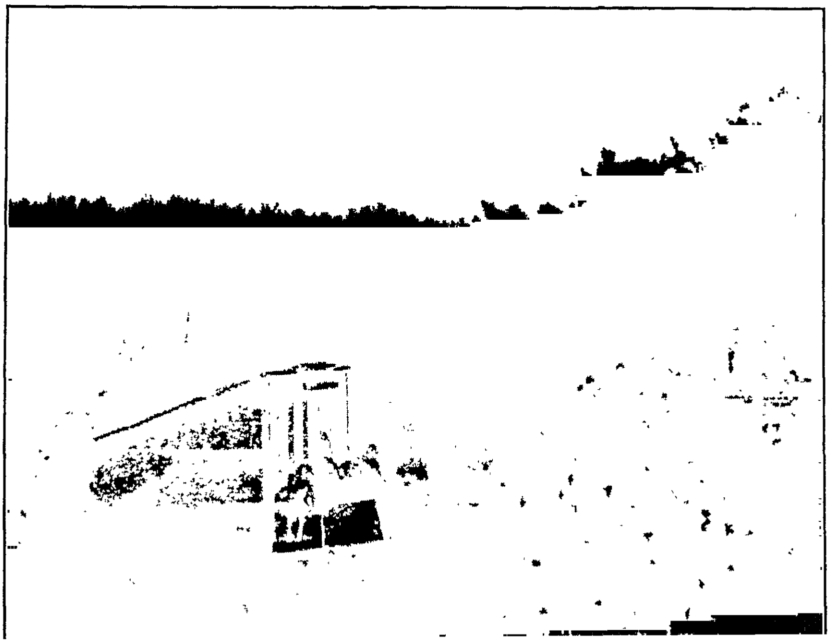

FIG. 4.—Showing a ladder placed across the coops. This induces the young Turkeys to perch in the open at an early age, and is also useful during the daytime when the ground is wet.

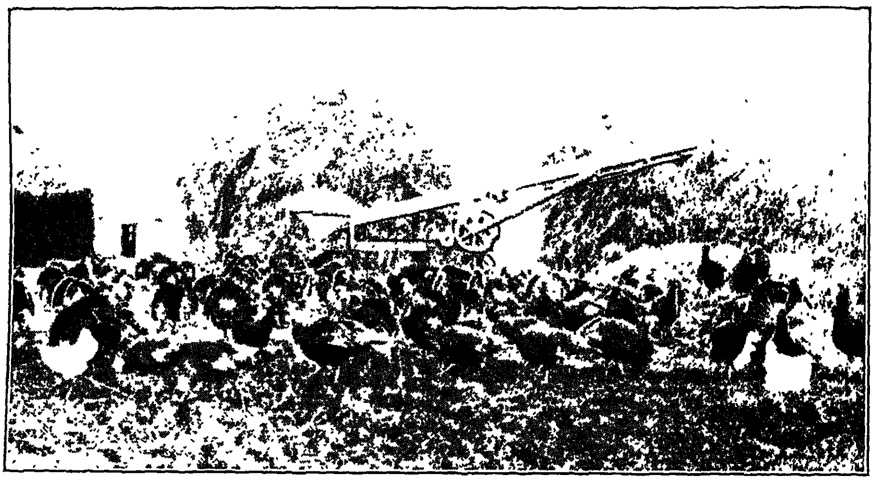

FIG. 5.—A Flock of Young Turkeys on the Ministry's Estate at Methwold.

selves. Irritation from lice alone, apart from the more serious effect of blood-sucking parasites, to several of which turkeys are frequently exposed, will quickly undermine the rather weak resistance of the turkey chick.

The Rearing of Turkeys.—Although a good deal has been indicated which may account for the losses in turkey rearing, much of the trouble which arises is undoubtedly due to mis-management. This can be more often attributed to ignorance than to carelessness. Although there is no room for careless management, it is quite common for too much care to be lavished upon the young turkey. Many of the most successful rearers are or have been gamekeepers, in whose methods there is no fuss or sentiment. As is the case in the management of most classes of stock, some have the natural skill which others will never acquire.

Many thousands of turkeys have been successfully raised this season in spite of the cold and wet conditions during the critical periods of rearing, and the writer is not merely depending upon his personal experience for the following outline of methods which have proved successful. Much information has been freely given by Norfolk breeders for the benefit of others.

The Rearing Ground.—It is invariably advised that fresh ground should be used each season for cooping turkey chicks. This ground, moreover, should be free from previous occupation by other poultry stock. Objections may be raised to the difficulty in finding a site near enough at hand to prevent the exposure of the young birds to hawks and similar enemies, and to enable the rearer to drive the young birds to shelter in the event of rain. Both are common risks; it is doubtful in the latter case whether there is any risk except in a heavy storm. There is far greater risk in shutting the young birds in a stuffy coop or in a small run upon fouled ground. If it is necessary to continue to use a run attached to the coop in order to overcome both these difficulties it must be moved on to fresh ground twice daily. A covered run is in many cases advised for use during the first fortnight after hatching, but the choice of a sheltered spot with plenty of natural cover will minimise these risks; fresh ground, however, is essential. There is no doubt that the practice of cutting walks through growing clover or lucerne affords a good alternative in the choice of a cooping ground.

Feeding Young Turkeys.—The old well-tried methods of feeding are still adhered to by many and have produced some of the finest results. Chopped eggs—even hard boiled, although the writer infinitely prefers to scramble them with milk—with fine biscuit meal (scalded), chopped onion tops in abundance, middlings and milk are the most favoured foods in the early stages. Soured milk curds, which are freely used in Devon, are seldom given in Norfolk, where fresh whole or skim milk is highly valued by the rearers and given when available. The young birds are fed little and often.

As the youngsters develop, cracked maize, boiled and mixed with middlings, ground oats and sometimes barley meal, are given, but the last is less favoured and ground oats is often considered unreliable and too expensive. The value of animal food is widely recognised, and the natural supply of insect life is sometimes augmented by maggots from the decaying carcases of animals, *e.g.*, rabbits and other vermin which are suspended or partially buried to decay and provide the supply. Meat meal is used, but care must be exercised as to quality. Fresh meat offal boiled and finely chopped is also recommended.

Crumbly and wet mash are most favoured for the production of the best quality birds, but some dry grain is also included in the diet, and three feeds daily are provided throughout. Groats and cracked wheat are fed while the turkeys are small, and wheat and oats of good quality as the birds develop. Green food is of the utmost importance, but with the selection of a suitable rearing ground its provision is unnecessary. Nettles are always welcome to the turkey rearer, and the use of nettle tea for mixing the mash will frequently have a good effect upon ailing birds.

The young birds should be allowed unlimited range, and every inducement should be given them to seek their own food.

General Management.—One of the greatest evils is overcrowding. Coops are often too small and ill-ventilated. Eight turkeys to a hen are a sufficient number and the coops should be placed *at least* 15 yards apart; even at this distance the hen with a particularly loud cluck will gather recruits from her neighbours. So long as coops or houses are in use the number of occupants must be limited. Whilst it may be necessary to provide a house early in the season when the birds have outgrown the coop, it is well to leave the mother hen with them as long as she will stay to act the part of leader and protector.

It is a mistake to drive or encourage turkeys to roost in a house after they are well feathered and the season is advanced. The sooner the house can be removed and the birds induced to take to a tree the better, and in fox-free districts poles are provided in the open (see Fig. 4), and as an alternative to a tree. "Swelled head" trouble frequently follows the housing of turkeys.

Management of the Breeding Stock.—It is obvious that the breeding stock must be in good health in order to produce strong progeny. If the turkey hens are overfat or in poor condition the chicks will start under a handicap. The environment of the breeding flock is most important. A wide range over clean ground is as essential to the adult as to the young bird. To haunt the yards and mingle with other classes of poultry on ground which has probably borne generations of poultry stock is quite foreign to the nature of the turkey, and is harmful. To roost in a shed with other fowls is worse. The best turkey house is a tree. When protection is necessary rough shelters of the type illustrated (Fig. 2) are both suitable and inexpensive. To feed the turkeys in a dirty yard is again courting trouble.

Peas are an excellent food for stock turkeys for inclusion with wheat, oats or maize. Some meat is at times desirable, and green food can always be offered to supplement the natural supply. Roots—mangolds in particular—cannot be advocated in any quantity. Every inducement should be offered for the birds to range in search of their own requirements.

Failures in turkey rearing are unfortunate and hinder the development of an important industry. The losses are seldom if ever due to wilful neglect; often they are due to disease the causes of which are as yet unknown, and it is only by education and the co-operation of the practical with the scientific worker in research that an improved state of affairs can be hoped for in the future. In spite of the troubles, one cannot but feel optimistic for the future of turkey rearing while the vision of many fine flocks reared last season is still fresh in mind.

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JANUARY ON THE FARM.

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Seasonable Work.—At this time of year the soil is commonly too wet to allow of much team work; the good manager, however, endeavours to utilise his men in the performance of a variety of operations which are necessary to the proper upkeep of the farm, or which may, if performed at this season, facilitate progress on the land when the soil is in a fit condition for tillage. Many of the features which distinguish a tidy, well-managed holding, represent work done during periods when ordinary field operations are held up by unfavourable weather. Hedge-cutting; ditching and opening drain mouths; road mending; repairing gates; overhauling and painting tools, implements and machinery; repairing and dressing harness: these are examples of odd jobs suitable for January conditions. Boxing seed potatoes, liming, slagging pastures, and, where a breeding flock is kept, preparing the lambing pen, are other necessary or desirable operations.

One of the first rules of good management is " work as hard as you can to make ready for busy time." The busy time, viewed from the position in January, is the spring cleaning and sowing season. Accordingly it is desirable to carry out such operations possible in January as are likely to relieve the pressure of work in March and April. During hard frost in particular, yard manure may be carted out and applied to the land for coming roots; manures should be obtained, and seed corn should be dressed (winnowed) and bagged in readiness for sowing. It may be possible to sow a field or two this month. Beans and peas for February sowing should be obtained now.

The ploughing of leas for spring corn is frequently deferred till January, because the late-ploughed turf is not so liable to grow through the seams as is early ploughed grass, and because lea land will carry the horses at this time of the year when other land is too soft for team work. Land that grew roots in 1924 will require skimming-over at the earliest opportunity: where clover is to be sown in the ensuing corn crop, deep ploughing should be avoided at this stage, especially on land where clover is apt to miss: the fact that the plant may be good on the headlands and absent further in the field is probably due largely to the difference in depth of work.

Good sowing conditions are not commonly of long duration in January; on lighter soils, however, a few days' fine weather may afford the opportunity to sow or drill winter wheat, winter oats and even barley. Winter oats sown during January last year did very well in Derbyshire, even at elevations above 700 ft. and white varieties were as successful as blacks. Apparently seeds germinating at low temperatures produce seedlings of a very hardy character. Shallow covering is desirable at this season, but entails extra care to keep off birds. In two cases the importance of an application of active fertiliser was demonstrated on wheat sown about the end of the month.

Milk Yields.—During the past few years many farmers have adopted the commendable practice of varying the allowance of concentrated food according to the yields of the individual cows. Where daily records of milk yields are kept, very systematic feeding is possible: the quantity of concentrates each cow should receive may be marked down so as to be seen by the feeder when serving out her foods, and the figure may be revised from time to time according to the yield and body condition of the animal. Where the herd is recorded and fed with a properly balanced mixture, correctly rationed out, it may be taken for granted that the milk yield will be at its maximum, so far as feeding is concerned. The farmer who records his cows' yields gradually acquires correct knowledge of the yields at different stages of their lactation period, while the performance of his herd as a whole is shown by his "herd average," worked out at the end of the recording year.

Where records are not kept, the owner of the herd may be unable at any time to form a proper opinion as to whether his cows are yielding a reasonably good quantity of milk per day. Thinking the daily output unsatisfactory, he may increase the ration to the point of expensive production. On the other hand he may be unaware of the fact that his herd is milking badly, owing to poor cows, to inefficient milking, or to incorrect feeding. That farmers have not devoted sufficient attention to this matter may be proved by setting to an audience of milk producers such a problem as the following:—A dairy herd comprises 40 cows, of which 10 have been calved less than 3 months, 10 between 3 and 6 months, 10 between 6 and 9½ months and 10 more than 9½ months; the cows are regularly bred from, the object being a calf within the year: what is a fair daily yield of milk from such a herd?

In considering the daily yield of a herd, it is important to take into account the stage of lactation of the cattle. Obviously a herd of newly-calved cows should yield more milk per day than a herd most of which have been in milk for 6 months. Also more may be expected from mature cows than from first-calf heifers. For the purpose of criticising the yield of a mixed herd, however, the standard of comparison may be the performance of an average 700 gallon cow. The average daily yield of such an animal at different stages of lactation is as follows:—

1st three months	... ...	3.4 gallons.
2nd " "	... ...	2.6 "
3rd period, 3¼ months	... ...	1.4 "
4th " 2½ "	... ...	dry.

Applying these figures to the herd described in the above problem, the standard daily yield would be:—

10 at 3.4 gallons per day	... ...	34 gallons.
10 " 2.6 " " "	... ...	26 "
10 " 1.4 " " "	... ...	14 "
10 " 0 " " "	... ...	0 "
	Total ...	74 gallons.

If the daily output were only 60 gallons, the herd would be milking at the rate of about 568 gallons per annum. Unless it so happened that at the time in question most of the best cows were dry, such a low yield would be considered unsatisfactory and call for an investigation as to the causes. If the first group—the newly-calved cows—exceeded the standard quantity, it is likely that the cows were not at fault; poor yields and rather lean condition in the second group would suggest that the feeding during the preceding period had not been correct; and too early drying off would point to inefficient milking.

Cost of Food per Gallon of Milk.—The determination of the actual cost of producing a gallon of milk in any herd would require full cost accounts not only of the various items concerning the management of the herd itself, but also of the crops produced for consumption by the cattle. Useful information, however, may be obtained by quicker and simpler methods. Adopting standard prices for home-grown foods and purchase prices for bought foods, it is not difficult to arrive at a figure representing the cost of food per gallon of milk produced; which figure, when compared with a standard or with the corresponding figures for other similar herds, may be a means of calling attention to possible economies in production.

For the above purpose it is necessary to ascertain (1) the daily consumption of food by the entire herd, including dry

cows that are in-calf, and (2) the total yield of milk per day. The following example, typical of Derbyshire practice, indicates one method adopted:—

A herd of 40, of which particulars were given above, consumes daily the following quantities of food:—

				£ s. d.	Per head. lb.
Roots	18 cwt. at 9d.		=	13 6	50
Meadow hay	5 ,, at 4s.		=	1 0 0	14
Oat straw	1½ ,, at 3s.		=	4 6	4
Brewer's grains	11 bus. at 8d.		=	7 4	12½
Decorticated cotton seed meal	44 lb. at £13 10s.	per ton	=	5 3	Concentrates 3½lb. per gal. after the 1st.
Palm kernel meal	44 lb. at £9 10s.	per ton	=	3 9	
Rice meal	66 lb. at £9 15s.	per ton	=	5 9	
				£3 0 1	

If the daily yield of milk is 74 gallons, the cost of food per gallon is £3 0s. 1d. ÷ 74 = 9.7d.

If, at the time, the above herd included 20 cows that had calved less than three months ago, 10 calved between 3 and 6 months, and 10 calved more than 6 months ago, the daily yield should be about 108 gallons. On the same system of feeding, the daily cost would be:—

Maintenance and first gallon, as above... ...	£2 5 4
Meals, 3½ lb. per gallon after the first = 238 lb.	1 1 10
Total ...	£3 8 2

Cost of food per gallon = 7.6d.

In the same way it may be shown that if at the time there were none less than three months advanced in lactation, so that the daily yield was only 40 gallons, the cost of food per gallon would be 15.5d. on the same system of feeding.

In many counties farmers submit their herd rations to the County Agricultural Organiser for criticism, being especially interested in his estimate of the cost of food per gallon. The above examples indicate that, unless full particulars are furnished with regard to the stage of lactation of the cows in the herd, a very misleading figure may be arrived at. Comparisons of cost may properly be made only between herds similarly composed as regards the proportions of flush and stale milkers. Such comparisons, however, frequently reveal great differences, due largely to incorrect feeding. The apparent high cost of production from poor milking herds, and from herds in an advanced stage of lactation, is commonly increased by overfeeding the cows. Cows in full milk are more commonly underfed.

MANURES FOR JANUARY.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Manuring of Barley.—Field experiments conducted for the past three years under the auspices of the Institute of Brewing suggest some interesting points in regard to the maturing of malting barley. It is commonly supposed that malting barley should receive no manure, and where it is given anything at all, it receives either superphosphate or a compound fertiliser. A sample of one of the latter recently brought to our notice was found to contain fertilising substances equivalent to 2½ parts superphosphate to one part sulphate of ammonia with a little muriate of potash in addition, and was so priced that 5 cwt. per acre at a cost of £2 2s. 6d. supplied 2½ cwt. superphosphate, 1 cwt. sulphate of ammonia and ½ cwt. muriate of potash.

The Institute of Brewing experiments bring out the interesting point that nitrogenous manure can safely be given to malting barley, and so long as the crop stands up, there is every prospect of an increased yield and little fear of damage to the quality. The nitrogenous fertiliser actually given was sulphate of ammonia applied at the rate of 1 cwt. per acre. The average increased yield in the results so far collected has been :—

After a straw crop	...	6 bushels per acre
After roots fed off	...	5.2 " " "
After potatoes or beets	...	9.6 " " "

The samples were fully examined by malting experts and by a malting chemist, and it was not found that the quality had suffered. The result is remarkable, and indicates that the accepted recommendation to avoid nitrogenous fertilisers for malting barley is not altogether sound. So long as the barley can stand up and continue to grow, the addition of manures necessary to feed the extra growth appears to be without detriment to the market valuation. The experiments were made with Plumage Archer, a variety in which high malting quality is combined with considerable strength of straw and power of making growth. If the variety grown were one that tends to go down, or lacks the power to make growth corresponding to the food stuffs absorbed from the soil, then there might arise an accumulation of nitrogen in the grain, which, when it proceeds too far, apparently injures the quality.

Neither phosphates nor potash had so marked an effect as nitrogenous manure, either after roots fed off or after other crops;

it appears therefore that the recommendations for the manuring of malting barley require some reconsideration, and that farmers can aim at increased crops without necessarily lowering the market valuation.

Manuring of Potatoes.—The results of the Rothamsted potato experiments this year have again given interesting data. Without fertilisers, but on land in good condition, the yield was 6.6 tons per acre; this was raised to 7.2 tons by adding superphosphate and sulphate of ammonia (6 cwt. of the former and 2 cwt. of the latter per acre). When 2½ cwt. per acre sulphate of potash was given in addition the yield rose to 9.3 tons, a gain of over two tons per acre, and there was a further rise to 10.6 tons per acre when the whole dressing was doubled. The total difference in yield effected by the application of fertiliser was 4 tons per acre; the crop was sold at £7 per ton, making a gross additional return of £28; the expenditure in fertiliser on this heaviest manured plot was £8; while an expenditure of only half this amount (viz., £4) was incurred in the plot which had yielded the increase of 2.7 tons per acre.

These results were obtained on a heavy soil not well suited to the growth of potatoes: in these conditions the yield of 10.6 tons is distinctly satisfactory.

Equally interesting results were obtained by a study of the effect of varying the dressing of sulphate of ammonia. In this set of experiments the crop receiving no manure gave 6.5 tons per acre, while the addition of superphosphate and sulphate of potash gave a yield of 8 tons, an increase of 30 cwt. per acre. Now when 1½ cwt. sulphate of ammonia was added, the yield rose to 9.5 tons per acre, an increase of 1½ tons of potatoes for 1½ cwt. sulphate of ammonia; the potatoes sold for £7 per ton, while the sulphate of ammonia cost 23 shillings. Further increases in sulphate of ammonia gave some increase in yield, a total application of 4½ cwt. giving an additional 10 cwt. of potatoes, making the yield 10 tons per acre. Substitution of muriate of potash for sulphate of potash did not appreciably affect the result. When the phosphates and potash were also increased the yield rose still further to 11 tons per acre. There had thus been a gain of 3 tons of potatoes per acre by increasing the nitrogenous dressing, but this necessitated an increase in the dressing of potash and probably of phosphates also.

Manuring the Clover Ley.—One of the striking results of the year has been the advantage of giving some dressing to the clover ley. The soil at Rothamsted is distinctly heavy and would

not be expected to respond to potash, yet such is the need of clover for potassic fertiliser that gains of 8 cwt. per acre of clover hay were obtained in 1924 and 12 cwt. per acre in 1923, by supplying 1½ cwt. sulphate of potash to the barley in which the clover was sown; there is no reason to doubt that the muriate would have had the same effect. The barley showed no benefit from the potash, but the clover did.

The results also show that sulphate of ammonia applied to the barley at the rate of 1 cwt. per acre had no depressing effect on the clover, though injury might have been expected had the soil been acid.

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending December 3rd.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 0	13.17	13.12	13. 7	17. 3
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13. 5*	13. 3*	13. 5*	13. 5*	(N)12.18
„ „ „ neutral (N. 21.1 per cent.)	14. 8*	14. 8*	14. 8*	14. 8*	(N)13.8
Kainit (Pot. 12½ per cent.)	...	..	...	2. 2	3. 5
French Kainit (Pot. 14 per cent.)	2.15	2. 7	2. 5	2. 5	3. 3
„ „ (Pot. 20 per cent.)	2.19	2.12	...	2,10	2. 6
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.10	2. 7	2. 4
Muriate of Potash (Pot. 50 per cent.) ...	...	7. 5	6.10	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	11.10	11. 5	4. 8
Basic Slag (T.P. 30 per cent.)	3. 2	...	2.12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 7	1.11
„ (S.P. 30 per cent.) ...	3 5	3. 5	3. 8	3. 1	2. 0
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8. 7	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	7. 0†	7. 7†	6. 0	6. 7†	...
Fish Guano (N. 7½-8¼, T.P. 16-20 per cent.)	...	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ...	...	...	...	13. 7	...
Burnt Lump Lime	1. 8	1.17	1.18	2. 2§	...
Ground Lime	1. 14	2. 5	2. 8	1.16§	...
Ground Limestone	1. 1	...	1. 4	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Animal Nutrition Institute, Cambridge University.

Cotton Seed Meal Poisoning.—In dealing with the feeding value of Egyptian and Bombay cotton cakes last month, attention was drawn to the fact that occasional cases of poisoning occur, particularly in pigs, when cotton seed meal is fed. American work indicated that this toxicity was due to the presence of a definite toxic substance. Recent work carried out in Scotland throws an interesting light on the subject and indicates a possible explanation of the trouble. In an article published in the *Journal of Pathology and Bacteriology* J. P. M'Gowan calls attention to the similarity of the pathological symptoms that manifest themselves in pigs under conditions of iron deficiency and in cotton seed poisoning. He points out that the pathological changes occurring in iron deficiency in suckling pigs. and in cotton seed meal poisoning are similar, and it is interesting to note that in the treatment of cotton seed meal injury, the administration of iron salts to affected cases is frequently followed by beneficial results.

From the foregoing facts the inference seems to follow that cotton seed meal injury is not in the nature of a poisoning, but that the pathological condition that arises is due to an interference with the normal metabolism of iron in the animal cell.

The Use of Biscuit Meal for Poultry Feeding.—Biscuit meals are almost invariably used in mashes given to young chickens, and frequently form an ingredient in mashes used for adult birds. A few notes on their composition and feeding value may therefore be of interest, especially in view of the fact that farmers are now beginning to turn their attention to that somewhat neglected but profitable side of their industry, *i.e.*, poultry-keeping.

Biscuit meals consist chiefly of a blend of cereal meals and animal by-products, these substances being thoroughly incorporated and cooked at a temperature sufficiently high to form a biscuit. This biscuit is subsequently granulated to sizes suitable for the purposes for which they are sold. Owing to the thorough cooking necessary for the formation of a biscuit meal and the nature of the products sold, biscuit meals have several advantages for chick-feeding. They are easily digestible, contain very little fibre, and are in practically a sterile condition. They have also the purely mechanical or physical advantage of making up

DESCRIPTION.	Price per Qr. s. d.	Price per Qr. lb.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	—	—	12/10	12 17	0 15	12 2	71·6	3/5	1·83
Barley, British Feeding	—	—	12/3	12 5	0 12	11 13	71	3/3	1·74
,, Canadian :—									
No. 3 Western	43/3	400	12/1	12 2	0 12	11 10	71	3/3	1·74
,, 4 ,,	41/6	,,	11/7	11 12	0 12	11 0	71	3/1	1·65
,, American	42/-	,,	11/9	11 15	0 12	11 3	71	3/2	1·70
,, Danubian	42/6	,,	11/11	11 18	0 12	11 6	71	3/2	1·70
,, Karachi	44/-	,,	12/4	12 7	0 12	11 15	71	3/4	1·78
Oats, English, White	—	—	10/10	10 17	0 13	10 4	59·5	3/5	1·83
,, ,, Black and Grey	—	—	9/8	9 13	0 13	9 0	59·5	3/-	1·61
,, Scotch White	—	—	11/-	11 0	0 13	10 7	59·5	3/6	1·87
,, Canadian :—									
No. 2 Western	35/9	320	12/6	12 10	0 13	11 17	59·5	4/-	2·14
,, 3 ,,	34/3	,,	12/-	12 0	0 13	11 7	59·5	3/10	2·05
Maize, Argentine	44/-	480	10/3	10 5	0 13	9 12	81	2/4	1·25
Beans, English Winter	—	—	11/-	11 0	1 12	9 8	67	2/10	1·52
Peas, English Maple	—	—	12/11	12 18	1 8	11 10	69	3/4	1·78
,, Japanese	—	—	26/-	26 0†	1 8	24 12	69	7/2	3·84
Rye, Homegrown	—	—	11/-	11 0	0 15	10 5	71·6	2/10	1·52
Tares	—	—	10/8	10 13	1 13	9 0	69·7	2/7	1·38
Dari, Egyptian	—	—	11/-	11 0	0 15	10 5	75·2	2/9	1·47
,, Persian	—	—	12/-	12 0	0 15	11 5	75·2	3/-	1·61
Millers' Offals :—									
Bran, British	—	—	—	8 7	1 6	7 1	45	3/2	1·70
,, Broad	—	—	—	9 7	1 6	8 1	45	3/7	1·92
Middlings—									
Fine Imported	—	—	—	10 7	1 2	9 5	72	2/7	1·38
Coarse, British	—	—	—	9 2	1 2	8 0	64	2/6	1·34
Pollards, Imported	—	—	—	8 10	1 6	7 4	60	2/5	1·29
Meal, Barley	—	—	—	13 0	0 12	12 8	71	3/6	1·87
,, Maize	—	—	—	11 10	0 13	10 17	81	2/8	1·43
,, ,, South African	—	—	—	11 7†	0 13	10 14	81	2/8	1·43
,, ,, Germ	—	—	—	11 10	0 18	10 12	85·3	2/6	1·34
,, ,, Gluten Feed	—	—	—	11 10	1 7	10 3	75·6	2/8	1·43
,, Locust Bean	—	—	—	10 0	0 9	9 11	71·4	2/8	1·43
,, Bean	—	—	—	14 0	1 12	12 8	67	3/8	1·96
,, Fish	—	—	—	21 0	4 5	16 15	53	6/4	3·39
Linseed	—	—	—	22 10	1 11	20 19	119	3/6	1·87
,, Cake, English 12°/ₒ Oil	—	—	—	14 5	1 18	12 7	74	3/4	1·78
,, ,, 10°/ₒ Oil	—	—	—	13 15	1 18	11 17	74	3/2	1·70
,, ,, 9°/ₒ Oil	—	—	—	13 7	1 18	11 9	74	3/1	1·65
Cottonseed Cake, English 5½°/ₒ Oil	—	—	—	8 15	1 14	7 1	42	3/4	1·78
,, ,, Egyptian 5½°/ₒ Oil	—	—	—	8 12	1 14	6 18	42	3/3	1·74
Decorticated Cotton Seed Cake 7% Oil	—	—	—	12 5	2 13	9 12	71	2/8	1·43
Palm Kernel Cake 6°/ₒ Oil	—	—	—	9 15†	1 3	8 12	75	2/4	1·25
,, ,, Meal 2°/ₒ Oil	—	—	—	9 0*	1 4	7 16	71·3	2/2	1·16
Feeding Treacle	—	—	—	7 15	0 8	7 7	51	2/11	1·56
Brewers' Grains :—									
Dried Ale	—	—	—	9 0	1 4	7 16	49	3/2	1·70
,, Porter	—	—	—	8 10	1 4	7 6	49	3/-	1·61
Wet Ale	—	—	—	1 10	0 9	1 1	15	1/5	0·76
,, Porter	—	—	—	1 7	0 9	0 18	15	1/2	0·62
Malt Culms	—	—	—	8 10†	1 13	6 17	43	3/2	1·70

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of November and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 12s. 10d.; P_2O_5, 4s.; K_2O, 2s. 4d.

into a wet mash without causing stickiness, the incorporation of biscuit meal into a mash rendering the process of obtaining the mash in a dry crumbly condition an easy one.

Composition.—In the case of biscuit meals made by a well-known firm of biscuit meal manufacturers, three grades of biscuit meal are made. The chief ingredients used in all three meals are wheaten cereals and meat scrap. In the case of the chicken biscuit meal full cream milk powder from a reliable source is incorporated in addition, and in the case of the meal used for exhibition and game birds cod liver oil is added. The approximate composition of these meals is as follows:—

	(1) *Chicken Biscuit Meal.*	(2) *Poultry Biscuit Meal.*	(3) *Biscuit Meal for Game Exhibition Birds.*
Moisture	7.0	6.9	4.5
Protein	19.5	19.5	19.5
Fat	4.5	4.5	7.0
Carbs.	65.0	65.0	65.0
Fibre	0.5	0.6	0.5
Bone	3.5	3.5	3.5

Digestibility.—From the nature of the materials used in the manufacture of these meals the ingredients as shown by the analyses would be nearly all digestible. Assuming an all-round digestibility of 95 per cent., the nutritive ratio of the meals would be as follows:—Meal 1, 1 : 3.9; Meal 2, 1 : 3.9; Meal 3, 1 : 4.2. From the standpoint of chick-feeding, the meal is well balanced. In the case of adult birds, the meal if used could form one-quarter by weight of the total ration. A commonly used ration for this purpose is two parts of this biscuit meal added to six parts of a mixture of equal parts of bran, middlings. and either fish meal or meat meal.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·25	2 4	71·6	8 7	0 15	9 2
Oats	1·25	2 4	59·5	6 19	0 13	7 5
Barley	1·25	2 4	71·0	8 6	0 12	8 18
Potatoes	1·25	2 4	18·0	2 2	0 4	2 6
Swedes	1·25	2 4	7·0	0 16	0 2	0 18
Mangolds	1·25	2 4	6·0	0 14	0 3	0 17
Good Meadow Hay	1·70	3 2	31·0	4 18	0 13	5 11
Good Oat Straw	1·70	3 2	17·0	2 14	0 7	3 1
Good Clover Hay	1·70	3 2	32·0	5 1	1 0	6 1
Vetch and Oat Silage	1·47	2 9	14·0	1 19	0 7	2 6

Agricultural Wages Committees.

IN the case of four Committees, minimum rates have already been fixed (*see* p. 889). The majority of the other 43 Committees have arrived at preliminary decisions with regard to the minimum rates they propose to fix. Before the decisions can be confirmed, the Committees are required to give at least fourteen days' public notice of the rates proposed, and brief particulars are given below of the various notices of proposals advertised up to the 20th December.

Committee.	Rates proposed for adult male workers.	Special rates (if any) for Special Classes.	End of period for which rates will apply.
Bedford and Huntingdon	29/- for a week of 48 hr.	—	29th March, 1925.
Buckingham ...	30/- for a week of 50 hr. in summer and 48 hr. in winter	—	Last Saturday in Oct., 1925.
Cambridge and Isle of Ely	30/- for a week of 48 hr.	Horsemen, cowmen, shepherds, 37/- for a week of the hours necessary for the performance of customary duties	28th Feb., 1925.
Cumberland and Westmorland	30/- for a week of 54 hr. in summer and 48 hr. in winter	Workers hired on half-yearly or yearly engagements, 37/- for a week of customary hours	30th May, 1925.
Derbyshire ...	8d. per hr. for a guaranteed week of 54 hr.	—	15th Dec., 1925.
Dorset	30/- for a week of 51 hr.	—	6 months from the date of coming into operation.
Durham ...	32/- for a week of 50 hr.	Horsemen, 32/- per week of 50 hr. with additional sums for extra time spent in attention to horses. Stockmen and shepherds for the hours customarily spent in attention to stock, wages ranging from 36/- to 43/- per week.	13th May, 1925.

Committee.	Rates proposed for adult male workers.	Special rates (if any) for Special Classes.	End of period for which rates will apply.
Hampshire and Isle of Wight	30/- for a week of 51 hr. in summer and 48 hr. in winter	—	11th Oct., 1925.
Herefordshire...	31/- for a week of 52 hr. in summer and 48 hr. in winter	—	30th April, 1925.
Middlesex ...	34/4½ for a week of 50 hr. in summer, 33/- for a week of 48 hr. in winter	Stockmen, 41/3 for a week of 60 hr. Carters, 38/6 for a week of 56 hr.	12 months from the date of coming into operation.
Nottingham ...	32/- for a week of 50 hr.	—	31st October, 1925.
Stafford ...	7d. per hr. for a guaranteed week of 54 hr.	—	27th June, 1925.
Suffolk ...	7d. per hour for a guaranteed week of 50 hr. in summer and 48 hr. in winter	Horsemen, stockmen and shepherds, as for other workers, with the addition of 6/- per week for extra hours spent in attendance to animals	—
Surrey ...	32/3 for a week of 50 hr.	Stockmen, shepherds and horsemen, 38/8 for a week of 60 hr.	To continue until cancelled or varied.
Warwick ...	30/- for a week of 50 hr. in summer and 48 hr. in winter	—	Last Saturday in October, 1925.
Worcester ...	30/- for a week of 53 hr. in summer and 48 hr. in winter	—	—
Denbigh and Flint	30/6 for a week of 50 hr.	Teammen, cattlemen, cowmen, shepherds and bailiffs of 21 years and over, 37/- per week of 61 hr. (including Sunday)	Until 12 months from the date on which the Order becomes operative.

Committee.	Rates proposed for adult sale workers.	Special rates (if any) for Special Classes.	End of period for which rates will apply.
Merioneth and Montgomery	31/- for a week of 54 hr.	Stockmen, teamsters, carters and shepherds of 21 years and over, 34/- per week of 60 hr.	1st May, 1925.
Radnor and Brecon	31/- for a week of 52 hr. in summer and 50 hr. in winter	—	2nd April, 1925.

NOTE.—In some of the above cases the Committees have also reached preliminary decisions in regard to minimum rates for boys and female workers and overtime rates, and as to benefits and advantages which may be reckoned in part payment of minimum rates of wages.

Copies of the proposals in full can be obtained, free of charge, from the Ministry.

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Agricultural Returns, 1924.

THE Ministry's Annual Report on the acreage of crops and number of live stock in England and Wales in 1924 has now been published. Preliminary figures for the whole country were issued in August (*see* this *Journal* for September, 1924, p. 593), but the annual report gives the finally revised figures by counties.

The chief changes in cropping and live stock are discussed in the report, and special tables are included showing the variations in the acreage of the chief crops and in the number of live stock per thousand acres of crops and grass in each county in 1924 and the average for 1911-13.

Returns are included of the number of agricultural workers in each county. Figures are also given as to the number of poultry on agricultural holdings; similar figures have not been available since 1921.

The report, which forms Part I of the Agricultural Statistics for England and Wales, 1924, is published by H.M. Stationery Office, and may be purchased through any bookseller or direct from the Stationery Office, Adastral House, Kingsway, W.C.2, price 1s. 6d. net, post free 1s. 7½d.

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Marrow-stem and Thousand-headed Kale for Sheep.

THE discomforts suffered by sheep folded on heavy or sticky soils in a wet season are plain to all who see them. They can be reduced by growing marrow-stem and thousand-headed kale in preference to turnips and swedes. They stand well up from the ground and the edible portions are always clean. They contain less water and more protein than

swedes and turnips, consequently, weight for weight, their feeding value is greater. It also follows that less concentrated feeding stuffs are required to supplement them.

Sheep are not apt to " scour " on them as on ordinary roots. With their great expanse of leaves and extensive root systems they give out water freely, consequently the land dries under them more quickly after rain. Furthermore, a well-grown crop provides shelter from cold winds and driving rain. With kale, the laborious lifting, clamping, and cutting usually practised with swedes are, of course, unnecessary. The reduction also in the singling and side hoeing required makes kale a cheaper crop than swedes.

Marrow-stem is usually eaten before Christmas, but there is no particular reason for this, as it will withstand an average winter at least as far north as Cheshire, and if it is suitably manured it does not become unduly woody with age. Thousand-headed best fulfils the needs of late winter and early spring.

The yields obtainable depend more on cultivation and manuring than on the character of the season. In the south of England such crops respond to generous treatment more rapidly than do swedes, and once established they are practically independent of weather, whether drought or drain. The more heavily they are manured—within reasonable limits of course—the better they yield and the more tender and palatable is the foliage. This is an important point in connection with the full utilisation of the plant; stunted kale means hard, woody stems, unpalatable to stock, and a serious hindrance to subsequent cultivation. Manured as for mangolds a crop of marrow-stem kale recently seen in Cheshire weighed 28 tons per acre. In the south the yield should never be lower than that of swedes, while the feeding value is higher. As cleaning crops they are unsurpassed.

Kales may be drilled and left unthinned or roughly thinned or they may often be transplanted from a seed bed with advantage. On the whole the best results are obtained when the plants are left not too thickly in the rows.

For carting off neither wholly or partly, for feeding in yards or on grass, no crop is more suitable. Under this crop the ground is rarely too wet for carting purposes, and the labour of subsequent cutting is obviated. No matter what the age of the animals or the state of their teeth, all can deal with kale, some better than others, but under mixed stocking the last vestige of the plant will be fully utilised.

Committee.	Rates proposed for adult sale workers.	Special rates (if any) for Special Classes.	End of period for which rates will apply.
Merioneth and Montgomery	31/- for a week of 54 hr.	Stockmen, teamsters, carters and shepherds of 21 years and over, 34/- per week of 60 hr.	1st May, 1925.
Radnor and Brecon	31/- for a week of 52 hr. in summer and 50 hr. in winter	—	2nd April, 1925.

NOTE.—In some of the above cases the Committees have also reached preliminary decisions in regard to minimum rates for boys and female workers and overtime rates, and as to benefits and advantages which may be reckoned in part payment of minimum rates of wages.

Copies of the proposals in full can be obtained, free of charge, from the Ministry.

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Agricultural Returns, 1924.

THE Ministry's Annual Report on the acreage of crops and number of live stock in England and Wales in 1924 has now been published. Preliminary figures for the whole country were issued in August (*see* this *Journal* for September, 1924, p. 593), but the annual report gives the finally revised figures by counties.

The chief changes in cropping and live stock are discussed in the report, and special tables are included showing the variations in the acreage of the chief crops and in the number of live stock per thousand acres of crops and grass in each county in 1924 and the average for 1911-13.

Returns are included of the number of agricultural workers in each county. Figures are also given as to the number of poultry on agricultural holdings; similar figures have not been available since 1921.

The report, which forms Part I of the Agricultural Statistics for England and Wales, 1924, is published by H.M. Stationery Office, and may be purchased through any bookseller or direct from the Stationery Office, Adastral House, Kingsway, W.C.2, price 1s. 6d. net, post free 1s. 7½d.

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Marrow-stem and Thousand-headed Kale for Sheep.

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Kales might well occupy an important place on both arable and grass farms They are specially adapted for helping out grass in winter and for tiding over lambing. Grass flockmasters would, in a late spring, find such crops invaluable. When green vegetables are scarce, surplus kale can be sold to advantage for household use.

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Seed Potatoes.

FARMERS will now be thinking of ordering seed potatoes. Owing to a reduced acreage and a moderate crop last season, seed is likely to be dear. English growers know by long experience that a change from the north is beneficial, especially after hot, sunny seasons. Nevertheless, there is less risk of a poor crop from home-saved seed after a wet season like the last than after a hot, dry one, provided the stock has not been grown more than once. The soundest practice for potato growers, however, even in the north of England, is to grow a proportion of new seed every year.

Potato merchants and growers are reminded that no potatoes may be sold for planting unless they are the subject of a certificate in one of the forms prescribed under the Wart Disease of Potatoes Order of 1923; any growers who propose to sell any seed potatoes from the present year's crop are accordingly advised to make early application for the necessary certificate. Potatoes which have been grown outside Great Britain and Ireland, may not be planted or sold for planting except under licence from the Ministry of Agriculture. These licences will not be issued unless the potatoes were accompanied by the official health certificate, from the exporting country, required under the Destructive Insects and Pests Order, and until they have been examined by an Inspector of the Ministry and found to be healthy. It will be a condition of any licence issued for the sale of imported seed potatoes that the vendor shall keep a complete list of the names and addresses of all purchasers and inform each one in writing that the potatoes are imported potatoes and must not be planted, or sold for planting, until a further licence has been obtained from the Ministry.

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Agricultural Returns of England and Wales, 1924.

PRELIMINARY statement showing the estimated total produce and yield per acre of the potato and root crops in England and Wales in 1924, with comparisons for 1923, and the average yield per acre of the ten years 1914-1923.

Crops.	Estimated Total Produce.		Acreage.		Estimated Yield per Acre.		Average of the Ten Years 1914-23.
	1924.	1923.	**1924.**	1923.	**1924.**	1923.	
	Tons.	*Tons.*	*Acres.*	*Acres.*	*Tons.*	*Tons.*	*Tons.*
Potatoes -	**2,697,000**	2,758,000	**452,242**	466,653	**6·0**	5·9	6·2
Turnips & Swedes -	**11,585,000**	10,879,000	**830,933**	858,213	**13·9**	12·7	12·4
Mangolds	**7,843,000**	6,944,000	**388,184**	401,458	**20·2**	17·3	18·9

NOTE.

Potatoes.—The detailed estimates now available show that the yield per acre of potatoes over the whole of England and Wales, though somewhat under average, is rather heavier than was indicated by previous forecasts. The crop is now estimated at 6 tons per acre, or one-fifth of a ton below the 10 years' average. The yield per acre is very slightly better than in 1923, but as a result of the reduction in the acreage the total production is only 2,697,000 tons, or 61,000 tons less than the small crop of last year. On the whole there are more diseased tubers than in 1923, so that the deficiency as compared with last year in the quantity of potatoes which will be fit to market will probably be somewhat greater than the figures indicate. Many of the tubers were stored in dirty condition during the wet weather of October. On the whole yields are quite up to average in the eastern counties, but in the west and south-west they are very light.

Turnips and Swedes.—The season has favoured the growth of turnips and swedes in the east of the country, so that yields are heavy; in Norfolk the yield is estimated at over 4 tons per acre above the 10 years' average. In the west the wet weather caused the crop to grow much top, but many roots did not develop well, so that yields are often light, especially in Wales. The average yield per acre over the whole country is estimated at 13.9 tons, or 1½ tons per acre over average, and 1¼ tons heavier than last year. The estimated total production of 11,585,000 tons is 700,000 tons greater than in 1923, in spite of the reduction in area, and very nearly equal to the average of the 10 years 1914-23.

Mangolds.—The mangold crop is also better than usual, taking the country as a whole, but yields are appreciably below average in the west, where the crop suffered from the wet, and the roots are small. The yields per acre in the eastern and north-eastern counties have only been exceeded once in the last 20 years. The total production in the whole of England

and Wales is estimated at 7,843,000 tons, against 6,944,000 tons last year and 7,516,000 tons the 10 years' average. The average yield per acre of 20.2 tons is 1½ tons above average and practically 3 tons heavier than in 1923.

In most districts supplies of winter keep for live stock will be sufficient, and in the east of the country they are plentiful. The poor crops of roots in the west are counterbalanced in most cases by large stocks of hay, but on many of the later farms in the north and in Wales, where much of the hay was damaged, there is not too much winter fodder available.

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Fowls for Meat Production.

THE following note has been communicated by Mr. John Watson:—The production of the best table fowls has lately been rather neglected in the enthusiasm for laying tests. After trials extending over a long series of years, I have come to the conclusion that there is no "best breed" for producing meat. The ideal fowl should carry the maximum of meat, and the minimum of offal. The meat should be carried on a full, square breast, to such an extent as almost to hide the breast bone. The flesh should be white (not yellow), fine in texture, and of a gamey flavour, and the bone fine.

In my experiments this is the fowl I set out to produce. I rear most of the heavy breeds, including White Wyandottes, White Orpingtons, White and Salmon Faverolles, Houdans, and all the varieties of Sussex, but with none of these was I satisfied. I next crossed hens of the above breeds with Old English Game cocks, and it was only then that I got, in my opinion, the perfect meat fowl. The increase in weight, but more especially in the cockerels, was very marked.

The difficulty experienced by breeders of White Leghorns, and the lighter breeds generally, in disposing of their surplus cockerels, owing to their carrying so little meat, induced me to try the Old English Game cross in this direction, and I put an Old English stag with half a dozen Leghorn hens. At three months old the crossbred chickens were double the weight of the pure ones. The pullets came a lovely pile colour, were more fleshy, were hardier, and laid more eggs than either of the parent breeds. This cross would prove the solution of having to rear light breed cockerels at a loss.

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Register of Growers of Certified Stocks of Potatoes in 1924.

DURING the past season Inspectors of the Ministry have examined many fields of growing crops of potatoes of varieties which have been approved as immune from wart disease, with a view to the certification of the crops under the Wart Disease of Potatoes Order of 1923 as being true to type and reasonably free from rogues. A list of the growers of these certified stocks has been prepared and copies may be obtained, price 1s., from the Ministry. The names and addresses of growers of certified stocks of any particular variety, together with the numbers of the relative certificates, will also be supplied on application. Growers are reminded that the only potatoes which may be planted on land infected with wart disease are those from crops which have been so certified.

The names and addresses of growers of varieties not approved as immune from wart disease, whose crops have been inspected while growing and found to be true to type, are also given. Most potato growers realise the importance of planting true stocks, and the extension of the system of inspection to non-immune varieties will, it is hoped, be of material assistance both to growers and purchasers of seed potatoes.

The Board of Agriculture for Scotland has issued a similar register of Scottish growers of approved immune varieties, and copies can be obtained from the Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, price 2s. net, post free.

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Foot-and-Mouth Disease.— Since 20th November there have been four outbreaks of foot-and-mouth disease, and although these have involved two new disease centres, the position must be regarded as more satisfactory.

An outbreak occurred in the Staffs infected area on 22nd November, and after an interval of a week, disease appeared at Yardley, Hastings, Northants (a free district), neighbouring premises being also involved in a further outbreak on 1st December. An outbreak also occurred at Wellingborough on 18th December.

On 10th December, there was an outbreak at Necton, Swaffham, Norfolk, for which no origin can at present be assigned.

The outbreaks at Yardley, Hastings, and Swaffham necessitated the application of infected areas restrictions to areas within a radius of 15 miles from those places.

There are at present, 29th December, two areas only under restrictions in connection with these outbreaks, all others referred to in the *Journal* having been released from restrictions.

Importation of Live Stock into South Africa.—The High Commissioner for the Union of South Africa has received a cablegram

to the effect that the Union Government has decided to remove the embargo on the importation of cattle, sheep, pigs and goats from Great Britain and Ireland immediately, and that all cattle on arrival at a South African port will be quarantined for 28 days and submitted to the Tuberculin test before admission.

Imperial Forestry Institute.—The Imperial Forestry Institute at Oxford started work on 13th October, temporary accommodation having been provided in the School of Forestry building until arrangements can be completed for the erection of new buildings on another site. The Board of Governors of the Institute is now fully constituted and consists of the following:—

- Lord Clinton, Forestry Commissioner (Chairman);
- The Vice-Chancellor of Oxford University, Mr. J. Wells, M.A., Warden of Wadham College;
- The President of Magdalen, Sir Herbert Warren, K.C.V.O., M.A., Hon. D.C.L.;
- Professor W. G. S. Adams, Fellow of All Souls College;
- Mr. R. L. Robinson, O.B.E., Forestry Commissioner;
- Major R. D. Furse, D.S.O., Colonial Office;
- Colonel G. L. Courthope, M.P., Empire Forestry Association;
- Professor R. S. Troup, C.I.E., M.A., D.Sc., Director.

The following staff has already been appointed:—Director, Professor R. S. Troup, C.I.E., M.A., D.Sc.; Secretary, Mr. P. S. Spokes, B.Sc., M.A.; Lecturers—Economics of Forestry, Mr. W. E. Hiley, M.A.; Silviculture, Mr. H. G. Champion, M.A.; Mycology, Mr. W. R. Day, B.A., B.Sc.; Structure and Properties of Wood, Mr. L. Chalk, B.A. Other posts have yet to be filled. The Institute will, in addition, have the assistance of the following members of the staff of the School of Forestry: Forest Management, Mr. R. Bourne, M.A.; Surveying and Engineering, Mr. N. F. MacKenzie, Hon. M.A. The Forestry Commissioners have agreed to station at the Institute certain of their research officers. In spite of the fact that the Institute is not yet fully organised and that sufficient time has not yet elapsed for the attendance of students from all parts of the Empire, nine students, deputed by the Colonial Office and the Forestry Commissioners, have begun special courses, and further students are expected to join during the next few months.

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QUESTIONS IN PARLIAMENT.

Conference on Agriculture.—Mr. Maclean asked the Minister of Agriculture and Fisheries on the 11th December whether he was aware that there were 220,000 men farming between five acres and 50 acres per man; and whether he was prepared to give this body of men representation at the proposed agricultural conference?

Mr. Wood replied:—"According to the Ministry's Returns for the 4th June, 1924, the number of Agricultural Holdings in England and Wales above five, and not exceeding 50 acres was 191,471. As regards the second part of the question, so far as I am aware, the only organisation of national importance which can claim to represent the occupiers of those holdings is the National Farmers' Union, which comprises a considerable number of smallholders among its members, and which,

Lord H. Cavendish-Bentinck asked the Minister whether the agricultural interests of the northern counties, particularly that of stock-breeding, would be represented?

Mr. Wood said:—"In order to give the greatest freedom to the deliberations of the proposed agricultural conference, I have left to the various organisations invited to the conference an entirely free choice as to their representatives within the numbers laid down. It will be for the various organisations of landowners, farmers and workers themselves to ensure that the various interests within their respective branches of the industry have an opportunity of expressing their views."

Standard for Cheese and Cream.—Mr. Hurd asked the Minister on the 11th December when he proposed to take steps for the imposition of a legal minimum standard of fat-content applicable to both home-produced and imported whole-milk cheese and cream, as recommended by the Linlithgow Committee?

Mr. Wood replied that the extensive taking of samples of various kinds of cheese was considered a necessary preliminary to the consideration of this recommendation. The last of these samples was being analysed by the Government Laboratory, and when a report was received he would be in a better position to decide what further action, if any, was desirable.

Tuberculosis Order.—Mr. Rawson asked the Minister of Agriculture and Fisheries on 11th December, whether any representations had been received from local authorities by the Ministry requesting the reinstatement of the Ministry's Tuberculosis Order No. 9,160, dated 24th June, 1914; and what attitude His Majesty's Government proposed to adopt towards the question?

Mr. Wood replied: "Representations have been received from a number of local authorities and other bodies in favour of the revival of the operation of the Tuberculosis Order of 1914. The provision of the necessary funds for the payment of compensation to owners of animals slaughtered under the Order may require further legislation, and the financial aspect of the question is now under consideration."

Foot-and-Mouth Disease Investigation.—In answer to a question by Mr. Riley on 11th December, as to the progress being made by the scientific committee of investigation into foot-and-mouth disease, Mr. Wood said that experiments with small animals had been in progress at four laboratories for some months. An experimental station to accommodate larger animals was nearing completion, and would be ready early in the new year. The Committee proposed to issue a first progress report covering its work to the end of March next. Until then it would be difficult to make any statement as to the results achieved.

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NOTICES OF BOOKS.

Rats and How to Destroy Them.—(Mark Hovell, F.R.C.S. John Bale, Sons and Daniellson, Ltd., London. Price, 10s. 6d. net; post free, 11s. 3d. inland, 12s. abroad.) For 40 years or more Mr. Hovell has been carefully studying in his spare time the habits of rats and the most effective means of exterminating them. The result of his researches is given in this book, which Mr. S. L. Bensusan, who has written the introduction, claims to be probably the most complete and reliable work on rat destruction ever printed, whether in

English or in any other language. Mr. Hovell points out that in establishing themselves on any spot that takes their fancy, rats are bound by no other law than that of their own convenience. If not molested or not seriously troubled, they regard their habitat as a permanent home, and their numbers are only limited by the capacity of the place chosen to supply their needs. When the full limits of support have been reached they throw out colonies much as bees throw out swarms. In this connection the figures given in the book as to the fecundity of rats are interesting. It is stated that the total number of rats produced in a single year by a pair of rats and their descendants may be 1,130, and that if the calculation is extended to fourteen months the number may have reached 3,050.

The fact that rats consume or spoil much foodstuff in stacks, poultry runs, granaries, mills and warehouses, and also damage buildings and materials of various kinds, is well known, but few people realise how great is the total monetary loss thus caused annually in Great Britain. The precise amount is necessarily mainly a matter for conjecture; Mr. Hovell gives an estimate of £52,000,000 a year. The book explains very fully the various means of destroying rats, including ferrets, dogs, poisoning, blocking, flooding, and fumigation. The use of virus is fully discussed but is not recommended. Separate sections of the book are devoted to instructions as to how to deal with rats in houses, farms, stables, cow-houses, fowl-houses, pigsties, outbuildings and gardens.

The position which the author occupies in the medical profession adds weight to his remarks upon the rat as a carrier of various diseases. He observes that many people are under the impression that the Great Plague of London, which began in December, 1664, and is stated to have killed 68,595 human beings, was entirely ended by the Great Fire of London, which raged between 2nd and 6th September, 1666, but this is not the case. According to Mr. Hovell deaths from plague, in and around London, continued from time to time during the succeeding half century. All infected rats were not destroyed by the fire, and human beings became infected by the fleas that fed on them, though perhaps in some cases the fleas were carried from the rats to human beings by other animals. It is interesting to note that in Mr. Hovell's opinion plague is almost sure to occur from time to time in this country now that plague-infected rats have invaded the Eastern Counties, unless, at any rate, a very thorough system of destruction is organised and carried out.

Although the opinions expressed by Mr. Hovell on certain points may not be generally accepted, there is no doubt that the work constitutes a valuable contribution to the discussion of a problem which is yearly receiving an increased amount of attention, both on sanitary and economic grounds, not only in this country but throughout the civilised world.

A Short System of Farm Costing.—(H. R. J. Holmes. Oxford University Press, 6s. 6d. net.) The author, following up a suggestion made by Sir Daniel Hall in this *Journal* for June, 1924, has devised a simple system of farm costing which he explains in detail and applies to the working of an actual farm account.

The simplification mainly consists of replacing field and crop costs by arable land costs and introducing arbitrary figures for the cost of individual home-grown crops. The number of working accounts is thus reduced considerably. Record keeping is minimised by allocating the

labour of stockmen and carters direct to the department concerned, and other labour is charged on a flat rate basis. Mr. Holmes explains at length the whole system, starting with double entry book-keeping, and following on with the basis of valuation, the method of keeping the necessary working accounts and the farm records, finally working step by step through a farm account illustrated with the actual figures.

The appearance of this book is proof that the simplification does not produce inaccurate or unreliable results, and the chapter headed "Conclusion" points to the value to the farmer of costs accounts with interpretation. Whether this system lessens the clerical work and record keeping sufficiently to entice the ordinary farmer to adopt it is an open question, but the author has done the bulk of the work for him by the lucid and clear manner in which he explains his methods.

The initial loss in valuation which must arise in writing down from market to standard valuation, if accepted by the income tax authorities, should appeal to farmers.

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ADDITIONS TO THE LIBRARY.

Live Stock.

Congrès International pour l'Elevage de l'Espèce Bovine (1923).—Compte-Rendu des Travaux du Congrès organisé sous le haut patronage de S. M. la Reine des Pays Bas au Kurhaus à Schéveningue près de la Haye du 29 août au 4 sept. 1923. (796 pp.) Gen. Sec., H. G. A. Leignes Bakhoven, Leeuwarden, Holland. [63.60; 63.711; 63.711(*b*); 614.54.]

Corrie, F. E.—The Mineral Needs of Farm Stock. With Special Reference to the Supply of Lime and Phosphorous to Animals. Revised Edn. (32 pp.) The Author, Star Cottage, Lingfield, Surrey, 1924. [612.394.]

Dairying.

Walker-Tisdale, C. W., and *Robinson, T. R.*—Practical Buttermaking: A Treatise for Buttermakers and Students. Fifth Revision. (143 pp. + 12 pl.) London: Swarthmore Press, 1924, 3s. 6d. [63.72(02).]

Veterinary Science.

Herms, W. B.—Medical and Veterinary Entomology: A Textbook for use in Schools and Colleges as well as a Handbook for the use of Physicians, Veterinarians and Public Health Officials. Second Edition. (462 pp.) New York and London: Macmillan, 1923, 20s. [59.169.]

U.S. Department of Agriculture.—Department Circular 325:—Foot-and-Mouth Disease, with Special Reference to the Outbreak of 1914. (31 pp.) Washington, 1924. [619.2(*d*).]

Plant Diseases.

Kansas Agricultural Experiment Station.—Circular 107:—The Copper Carbonate Dust Method of Controlling Bunt of Wheat.—(14 pp.) Manhattan, 1924. [63.24.]

U.S. Department of Agriculture.—Dept. Circ. 321:—Control of Cucumber Mosaic in the Greenhouse. (5 pp. + 2 pl.) Washington, 1924.

Poultry.

Canada Department of Agriculture.—Bull. 38 (New Series):—Report of First Three Years' Canadian National Egg Laying Contests. (50 pp.) Ottawa, 1924. [63.651.]

Connecticut-Storrs Agricultural Experiment Station.—Bull. 111:—Experiments on Close Inbreeding in Fowls: A Preliminary Report. (pp. 137-172.) Storrs, 1923. [63.651.]

North Carolina Agricultural Experiment Station.—Technical Bull. 22:—Digestive Coefficients of Poultry Feeds and Rapidity of Digestion and Fate of Grit in the Fowl. (143 pp.) Raleigh, 1923. [63.651: 043.]

Idaho Agricultural Experiment Station.—Bull. 134:—The Value of Certain Protein Feeds (Meatmeal, Tankage, Peameal, Sour Milk, Fishmeal) for Production and Quality in Eggs. Three years' work, 1920-23. (8 pp.) Moscow, 1924. [63.651: 043.]

Engineering.

Thompson, A. Beeby.—Emergency Water Supplies for Military, Agricultural, and Colonial Purposes: Based on Experience of the Mediterranean Expeditionary Force Operations, with Special Reference to the use of Drive Tube Wells and Drilling. (180 pp.) London: Crosby Lockwood, 1924. 21s. [628.7(02).]

Economics.

Belle Bull, G. de.—Agriculture at the Cross Roads (an Analysis of the Position). (27 pp.) London: Harrison & Sons, Ltd., 1924, 6d. [338.1(04); 63.3433(42).]

Tawney, R. H., and *Power, E.*—Tudor Economic Documents: Being Select Documents Illustrating the Economic and Social History of Tudor England. Vol. I.—Agriculture and Industry. (396 pp.) London: Longmans, Green & Co., 1924, 15s. [63(09).]

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SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

The Improvement of Races of Agricultural Plants and Live Stock and Modern Genetics, *G. Brunelli.* (Int. Rev. Sci. & Pract. Agr., vol. ii (new series), No. 3, July-Sept., 1924, 523-553.) [575.4.]

Agricultural Costing. An Aid to Farm Management, *E. P. Weller.* (Trans. Surveyors' Inst., 1924-25, vol. lvii, pt. 1, pp. 30-58.) [657.]

Plant Pests and Diseases.

Certain Aspects of the Damage to Oats by the Frit Fly, *J. C. F. Fryer* and *J. E. Collin.* (Ann. App. Biol., vol. xi, Nos. 3 and 4, Oct., 1924, pp. 448-464.) [63.27.]

Oscinella frit, Linn. An Investigation to Determine how far Varietal Differences may Influence Infestation of the Oat Plant, *N. Cunliffe* and *J. C. F. Fryer.* (Ann. App. Biol., vol. xi. Nos. 3 and 4, Oct., 1924, pp. 465-481.) [63.27.]

The Apple Bud Weevil, *Anthonomus cinctus*, Koll, *F. R. Petherbridge* and *J. W. Cowland.* (Ann. App. Biol., vol. xi, Nos. 3 and 4, Oct., 1924, pp. 482-497.) [63.27.]

Preliminary Report on the Use of Calcium Cyanide as a Soil Fumigant for Wireworms, *R. E. Campbell.* (Jour. Econ. Entom., vol. 17, No. 5, Oct., 1924, pp. 562-567.) [63.27.]

Functional Diseases of Apples in Cold Storage, *F. Kidd* and *C. West.* (Int. Rev. Sci. & Pract. Agr., vol. ii (new series), No. 3, July-Sept., 1924, pp. 594-603, pl. 37-48.) [63.21; 664.85.]

The Crown Gall Disease of Nursery Stocks. 1.—Field Observations on Apple Stocks, *H. Wormald* and *N. H. Grubb.* (Ann. App. Biol., vol. xi, Nos. 3 and 4, Oct., 1924, pp. 278-291, pl. 8 and 9.) [63.23.]

Loose Smut of Wheat. 1.—Seed Disinfection by Hot Water, *J. C. Neill.* (N.Z. Jour. Agr., vol. 29, No. 3, Sept., 1924, pp. 177-187.) [63.24.]

The Development of Blight in Potatoes subsequent to Digging, *P. A. Murphy* and *R. McKay.* (Irish Free State Jour. Dept. Land & Agr., vol. 24, No. 2, Aug., 1924, pp. 103-116.) [63.24.]

Live Stock.

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NOTES FOR THE MONTH.

THE thought uppermost in the mind of the farmer to-day is the sodden state of the ground. It is not only his arable that is water-logged, but his grass as well, while the yards and the approaches to the buildings are wellnigh impassable.

Faggot or Bush Draining.

As regards the yards and buildings, it is, of course, essential that the roof-gutterings should be intact and functioning properly. We must leave it at that and deal with the fields. Tile drainage on any appreciable scale, is out of the question owing to the cost, but much can be done by mole-draining. Faggot or bush draining, which is an ancient practice still in use in several localities, especially in the Eastern Counties, might, however, in connection with mole-drainage on heavy clay soils, be usefully extended. It might also be adopted on boggy land or other soils where pipe drains might shift. Faggot drains may be expected to last for 20 years or more.

The object aimed at is to secure an underground passage for water. In the case of a faggot drain this is gained by laying brushwood and other material in the bottom of a trench in such a way as to support the covering soil without either itself impeding the flow or allowing the soil to drop through and choke the drain. Later, when the brushwood rots, the passage becomes clearer.

The trench should be dug with steeply sloping sides and narrowed to a width of not more than 3 in. at the bottom. It is important that the trench should be cut narrow, the lower spits being removed by a special narrow spade and the bottom finished by a draining scoop.

Overgrown hedges provide suitable filling material which, as the hedges have to be cut in any case, costs nothing. Whitethorn and blackthorn are best adapted for this purpose, but any fairly straight wood, provided it is freshly cut and green, may be used. The brush should be cut about 2 in. diameter at the butt; if

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smaller, it should be more bunched together. It should be as nearly as possible of the same length, and projecting branches should be nicked with the bill to facilitate packing in the drain.

It is important to remember that the bushy ends must be kept on top and pointing away from the outfall. Laying, therefore, must begin at the head of the drain and proceed towards the outfall. The butts must rest on the bottom of the trench and each fresh butt must be placed a little more towards the outfall than the last, so that the sticks overlap continuously. In this way the bushy ends will act as a support to the covering soil and help to keep the channel clear. The brush is secured in the trench, working from above, not in the trench, by a crotched stick and then trodden firm, and when pressed down should have a depth of not more than 6 or 7 in. Above the wood, straw, rushes, or hedge brushings are laid to a depth of 2 to 3 in.

Filling in should proceed from the outfall towards the head, so as to ensure proper overlapping of the fine twigs. The lower spits, usually tenacious clay which will have been kept separate from the top soil, should be laid upon the straw by hand and well trodden down. After this the plough and the shovel may be used, but if the tough lower spits are not first placed firmly in position, the more friable top soil may fall through and check the flow of water in the drain. If carefully laid the lower spits tend to form a solid arch.

In cases where the bush drain runs through a headland into a ditch, pipes should be laid under the headland, otherwise the drain may be squeezed by pressure overhead.

When bush drains are to be used as mains in connection with mole-drains, they are usually completed first at least 6 in. deeper than the depth at which the mole is to be drawn. When the mole-draining is being carried out the mole is drawn across the main drain just above the brush, and unless the clay immediately above has been rammed tight or some time has elapsed for the settling of the covering soil the mole channel may break over the bush drain and interfere with free drainage. On the whole it is, perhaps, preferable to postpone mole-draining for some months after the bush drains have been made.

In a year such as this, many farmers are finding that the old tile drains are quite inadequate to deal with the unusual rainfall. They may have been placed too deep or too wide apart or, in the more impervious clays the jointings may have become impenetrable by water. Mole draining has this advantage: it is cheap; the mole can be tractor-drawn about 18 to 20 in. deep,

or deeper if steam tackle is used, and at frequent intervals, and if the bush main drains have been properly constructed water in heavy clay soils penetrates even more readily to them than to tile drains.

* * * * * *

The Agricultural Census, 1925.

SOME account of the Agricultural Census of Production which is to be taken this year in England and Wales, was given in a paper read before the Royal Statistical Society by Mr. R. J. Thompson, C.B., Assistant Secretary to the Ministry of Agriculture and Fisheries, on 20th January, 1925.

Much of the information required is obtained annually by the Ministry, but the more extended inquiry which is being undertaken this year is directed to filling up gaps and obtaining information on particular points, such as the production of milk, meat, and wool, and of market garden and glasshouse crops. In this task the Ministry is receiving welcome support and assistance from the industries concerned. The representative organisations have been consulted as to the questions to be asked on the forms, and the letters proposed to be sent to growers asking for returns state that the association concerned associates itself with the Ministry in asking for the desired information, which is needed for the advancement and in the interest of the trade.

The value of agricultural statistics, particularly with regard to products which enter into international trade, is now well recognised by farmers. The more exact and precise such estimates can be made, so much the more will price fluctuations based on incorrect or biassed statements tend to be eliminated. If official and unbiassed estimates of this type did not exist market prices would be influenced by unreliable rumours of all descriptions, and would be liable to manipulation by persons who were able to obtain early information. Great improvements in the collection of agricultural statistics have been effected in recent years, but a further step towards making them more reliable would be the taking of a uniform agricultural census throughout the world. In the future it is hoped to take such a census on a scheme to be arranged through the International Institute of Agriculture at Rome.

One of the most important pieces of information which an agricultural census can be made to supply is the classification of holdings by size. The usual type of statistics, giving, for example, the production of wheat or the number of live stock in a county does not enable us to compare the results from different

types of holding, or the distribution of crops and live stock on holdings of different sizes. It is proposed in this census to divide the agricultural holdings of this country—excluding small holdings, fruit and market gardens and poultry farms—into three groups which afford some indication of the nature of the farming carried on, viz.:—(1) arable farms, with 70 per cent. and over of arable land, (2) pasture farms, with 70 per cent. and over of pasture land, and (3) mixed farms, being the remaining farms lying between these two extremes. The three classes would in their turn be divided according to sizes. Thus we shall have the number and size of holdings of these different types in different counties, and the average distribution of crops and live stock on these holdings, the labour employed and other particulars.

Other information to be obtained, either by direct returns or by making approximate estimates, consists of the area under crops and number of live stock kept, estimates of production, including market garden production and crops under glass, motive power on the farm, capital and labour employed.

* * * * * *

Scheme for Milking Competitions.

THE Ministry wishes to draw the attention of Local Education Authorities, Agricultural Societies, etc., to the following Model Scheme of Milking Competitions, which has been recommended by the Committee appointed to consider the question of clean milk competitions.*

The Committee felt that milking competitions as at present conducted do not usually take sufficient account of the importance of producing clean milk, as distinct from the efficiency of the actual milking process. They suggest, therefore, a scale of marks which has been drawn up in order to lay due emphasis on both aspects of the matter. The Ministry agrees with the views of the Committee, and hopes that organisers of milking competitions will adopt the proposed scheme as far as practicable, and that such competitions may be more widely organised

SCHEME. — (1) Objects of the Milking Competition. To improve the efficiency of milking, having regard to the importance of producing a clean product.

(2) Instructions.—The County Dairy Instructor should be available to visit and advise competitors before the holding of the competition.

* The first report of the Committee, which took the form of a Guide to the Conduct of Clean Milk Competitions, has been published by the Ministry as Miscellaneous Publication No. 43. Copies may be obtained from the Ministry's Office, 10, Whitehall Place, S.W.1, price 6d., post free.

(3) Conditions governing competition:—

(a) *Eligibility.*—Persons regularly employed in milking dairy cows within a specified area should be eligible to enter, and classifications according to age should be made. The broad division should be over and under the age of 16, but in the event of a large number competing a more detailed classification should be arranged.

(b) *Cows selected.*—The cows to be milked should be selected, and, if possible, milk recorded, animals; they should in any case be under the control of the organising authority during the twenty-four hours preceding the competition, and particulars of their milk yield, and of the difficulty or otherwise of milking them, notified to the judge. This information is necessary in order that the judge may fairly assess the capability of competitors.

(c) *Number of cows to be milked.*—The greater the number of cows the competitor has to milk, the better the test; where circumstances permit, it is desirable that each competitor should milk not less than two cows.

(d) *Milking.*—Deliberate wet-handed milking should be regarded as a disqualification.

(4) *Scale of marks.*—

Cleanliness and type of equipment* used	10
Personal cleanliness of milker and suitability of dress	10
General style of approach and management of cow	8
Preparation of cow	10
Management of foremilk	7
Skill in milking (grip, motion, etc.)	20
Time taken in relation to quantity of milk obtained	10
Thorough stripping	15
Cleanliness of milk	10
	100

* The Authority under whose auspices the competition is held should state precisely the nature of the equipment which will be provided for the use of each competitor, and at the same time indicate that competitors may, if they prefer, bring and use their own equipment.

(5) *Prizes.*—The scheme of prizes varies of course with the organising authority. It is important, however, that the skill of competitors should be recognised by an award (*e.g.*, small money prizes and/or certificates).

(6) *Reports.*—A report might be issued to each competitor to include details of the marks awarded as compared with the maxima. The competitor can then see the points in which his (or her) methods need improvement.

* * * *

Committee on Agricultural Meteorology.

IN the Report of the Meteorological Committee of the Agricultural Research Council which was adopted in July, 1922, it was recommended that systematic records of crops and weather should be taken on a common plan at about 20 experimental stations, and that the Ministry should arrange for the correlation of the two sets of records. In order

to formulate a scheme for collecting data, the Ministry summoned a conference consisting of one representative from each Institution mentioned in the Report, and representatives of the Meteorological Office and the Ministry. The conference agreed on the meteorological and crop data which should be collected, leaving the details to be worked out by various sub-committees.

On the Report of a sub-committee on the Correlation of Data the Ministry is now acting. In that Report it was recommended that the various sub-committees should remain in existence in order to review and report annually on their respective sections of the Scheme.

In place of the temporary conference and sub-committees, the Minister has now appointed a Permanent Committee to advise the Ministry on all questions relating to agricultural meteorology. The Committee is constituted as follows:—

Sir Napier Shaw, F.R.S. (Chairman).
Professor V. H. Blackman, D.Sc., F.R.S.
Mr. R. Corless, O.B.E., M.A.
Mr. R. A. Fisher, M.A.
Mr. J. C. F. Fryer, M.A.
Mr. R. H. Hooker, M.A., F.R.Met.S., F.S.S.
Mr. R. G. K. Lempfert, C.B.E., M.A.
Sir T. Middleton, K.B.E., C.B.
Mr. J. Ramsay, O.B.E.
Mr. H. G. Richardson, M.A., B.Sc.
Mr. W. R. Black, B.Sc. (Secretary).

It is hoped to publish a full account of the Scheme in an early issue of this *Journal*.

* * * * * *

Wart Disease Immunity Trials, Season 1925.

THE Ministry will continue during the coming season to test at the Potato Testing Station of the National Institute of Agricultural Botany at Ormskirk, potatoes and potato seedlings as to their immunity from or susceptibility to wart disease on the usual conditions. A form of entry may be obtained from the Ministry, 10, Whitehall Place, S.W.1, or from the Potato Testing Station, Lathom, Ormskirk, Lancs. The completed form should be returned not later than 28th February.

Seedling Trials.—The Ministry desires to encourage the breeding of new varieties of potatoes, and in order to provide information for breeders of seedlings it is prepared to accept not fewer than 2 tubers, and not more than 10 tubers of any seedlings for growing for one season on the trial plots, and to furnish a report on the results obtained without payment of a fee. These tests, however, will not be considered as forming part of the Immunity Trials proper, and the results of these tests will not

Hops: Cultivation, Diseases and Insect Pests.

THE Ministry's new publication on "Cultivation; Diseases and Insect Pests of the Hop Crop"* should prove of great value to growers and those who contemplate growing hops. No British crop requires so much skill in cultivation nor so much technical and scientific knowledge on the part of the grower as the hop, and the subject is very thoroughly dealt with in the new handbook. There are full notes on the selection and preparation of sites, propagation and planting, planting out, and the cutting and cultivation stages. Manuring, which is of such special importance to the hop crop, receives careful notice, typical schemes being given to illustrate the standard commonly adopted by successful growers. The best systems and methods of training the plant are described and illustrated by diagrams, and the varieties which are of the highest commercial value are indicated. The need of great care in the picking, drying and packing processes is also emphasised.

The second section of the work deals with the diseases of the crop, and gives valuable information as to the earliest symptoms and preventive measures in the case of mould, hop canker and various diseases, as well as three recently discovered diseases—hop leaf spot, hop drop and downy mildew.

The last section contains an exhaustive account of insects that feed on the hop, their life-history, natural enemies, prevention and treatment, ranging from the chief enemy, the hop aphid, to those which are only of local or occasional importance.

Altogether the handbook runs into 82 pages, is written in language not too scientific for the average reader readily to grasp, and its utility is considerably heightened by the 68 photographs and diagrams which it contains.

* * * * * *

The Ministry's Exhibit at Wembley, 1925.

IN connection with the British Empire Exhibition, which is expected to open in May next, arrangements have again been made for the staging of a research exhibit by the Ministry, largely on the lines of last year. Owing, however, to a proposal that the whole of the first floor will be taken up by a Services' Exhibit, the Ministry has had to be content with a gallery on the ground floor. It is hoped, however, that what the exhibit may suffer as regards position will be compensated for by the addition of several new and popular exhibits dealing with Land Drainage, Apiculture and other of the Ministry's activities. Fuller details will be published in this *Journal* later.

* Miscellaneous Publications No. 42, obtainable from the Ministry's

"Wasps."

THIS new booklet (Misc. Pubn. No. 44) is a companion volume to Beneficial Insects (Misc. Pubn. No. 37). It deals with the seven social species of. British wasps, including the hornet, all of which are illustrated on a coloured plate.

It is hoped that the simple descriptions and the notes on the life history and habits of the insects may afford some assistance to inquirers. Opportunity has been taken to append some remarks on the control of wasps.

"Wasps" and "Beneficial Insects" may be obtained from the Ministry, price 4d. each, post free.

* * * * * *

Progress of Agricultural Wages Committees.

THE forty-seven Agricultural Wages Committees, covering the whole of England and Wales, were established simultaneously on the 18th October, last, and within a month of that date forty-two Committees had agreed upon the selection of their Chairmen. In the remaining cases at the Committees' request the appointment of Chairman was made by the Ministry.

The Committees appear to have settled down to their task of fixing minimum rates of wages in a spirit of friendly co-operation, and the progress which has been made up to the present is very striking. Out of the forty-seven Committees, no fewer than forty-two have agreed on the rates to be fixed.

As the power and duty of fixing minimum rates of wages rests with the Committees themselves, the function of the Central Wages Board (unless cases arise in which a Committee fails to fix a rate within the specified time) is confined to implementing Orders giving effect to the rates fixed by Committees, and specifying the date from which such rates shall operate. The Wages Board has already received notifications fixing rates from twelve Committees, and has put the rates into operation accordingly. Rates in the case of Berkshire, Essex, Norfolk and Anglesey and Carnarvon, have been in operation since the 29th December (brief particulars were given in the January issue of the *Journal*, p. 889) and particulars of the further rates fixed at the meeting of the Wages Board held on the 13th January are given on p. 1076.

As regards the remaining thirty-five Committees, formal proposals to fix minimum rates of wages have been advertised in thirty-three cases (particulars of which are given on p. 1077), and in the other cases, the Committees have reached preliminary

decisions, and it is expected that they will give formal notice of their proposals very shortly.

The rates so far fixed or proposed by the Committees show general advances on the rates of wages previously being paid ranging from 1s. to 5s. per week, the lowest rates fixed or proposed so far being 28s. per week for the present winter in Norfolk and Suffolk. In two other areas, the commencing rate for ordinary workers is also below 30s.; in 16 cases it is 30s.; and in 30 cases is above 30s. In several of the areas where the weekly rate is higher than 30s. the hours are correspondingly longer, *e.g.*, the rate of 42s. proposed for the eastern division of Lancashire is in respect of a week of 60 hours. Special rates of wages have been fixed for stockmen and other special class workers in twenty-one areas, such rates being from 5s. to 11s. per week higher than the rates proposed for ordinary workers in the areas concerned.

In addition to the fixing of minimum and overtime rates of wages the Committees are also making steady progress with the definition of benefits and advantages which may be reckoned in part payment of minimum rates of wages in lieu of payment in cash, and are proceeding to make arrangements to deal with applications for permits of exemption from the full minimum rates for infirm and disabled workers.

* * * * * *

The Agricultural Index Number.

THE general index number of the prices of agricultural produce in December showed a slight decline, the rise of one point recorded in November being lost. The average increase over December prices in the years 1911 to 1913 was 63 per cent., which compares with 56 per cent. a year ago and 59 per cent. in December, 1922.

Prices of all kinds of British grain were lower than in November, 1924, the decline being most marked in the case of barley. Grain usually becomes rather cheaper towards the end of the year, but the reductions in 1924 were relatively sharper than before the war, and in each case the index number shows a fall. Wheat averaged 12s. 3d. per cwt., or 4d. less than in November, the index number declining by 1 point to 67 per cent. above pre-war. Barley was 76 per cent. above 1911-13, against 89 per cent. above in the previous month, the drop in the average price being 1s. 7d. per cwt. Oats were relatively very cheap at an average of 9s. 7d. per cwt., or only 37 per cent. above 1911-13. Wheat and barley were much dearer than at

December, 1923, were practically at the same level as in December, 1922.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	59
September	202	116	57	56	60
October ...	194	86	59	51	63
November	193	79	62	53	64
December	184	76	59	56	63

The Christmas demand for meat caused a rise in the prices of all classes of fat stock, but the advances in the case of cattle and sheep were relatively smaller than in the base years, so that the index numbers were lower. Fat cattle were only 44 per cent. above pre-war, against 47 per cent. in November and 48 and 49 per cent. in December, 1922 and 1923 respectively. The drop on the month in the index number for fat sheep was 6 points, bringing the figure to 84 per cent. above 1911-13, but this was 12 points higher than a year earlier and 3 points above December, 1922. Fat pigs were again dearer and averaged 49 per cent. above pre-war, which compares with the minimum of 31 per cent. above in July. Bacon pigs were about 1s. per stone dressed carcass weight dearer than last December, but porkers, at an average of 11s. 5d. per stone, were selling at practically the same prices as at the end of 1923.

Dairy cows were from 15s. to £1 per head cheaper than in the previous month, and averaged 55 per cent. above 1911-13. All classes of store stock became rather dearer in December, but the rise in the case of store sheep was relatively smaller than in 1911-13 and the index number consequently shows a reduction. The advance in store pig prices caused a rise of 5 points in the index number, store pigs in December being 38 per cent. above pre-war. Store cattle at 37 per cent. above 1911-13 showed little change on the month.

The index numbers of milk and butter were practically unchanged on the month, the former remaining at 82 per cent. and the latter declining by 1 point to 73 per cent. above 1911-13. Cheese, however, showed a sharp advance and averaged 11s.

per cwt. more than in November, the index figure advancing by 13 points to 51 per cent. above pre-war. Eggs furnished the most outstanding change in price level of any commodity in December. Prices usually begin to fall about the middle of November, but the decline this winter has been exceptionally sharp, the average for December being 8½d. per dozen below that for November. Eggs, therefore, were only 51 per cent. above pre-war last month against 84 per cent. in November. Poultry at 64 per cent. above December in 1911 to 1913 was 13 points lower than before Christmas, 1923, all classes of poultry being cheaper than a year ago.

Potato prices were unchanged on the month, but, as there is usually a slight rise in December the index number declined by 2 points. Potatoes, however, remained very dear at 166 per cent. above pre-war prices. Other vegetables on the average were rather dearer than in November, and averaged 41 per cent. above 1911-13. Cauliflowers at 84 per cent. above pre-war and celery at 73 per cent. were relatively dear. Onions were 36 per cent., cabbage 27 per cent., Brussels sprouts 18 per cent., and carrots only 8 per cent. above 1911-13.

Index numbers of different commodities during recent months and in December, 1922 and 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1922.	1923.	1924.			
Commodity.	Dec.	Dec.	Sept.	Oct.	Nov.	Dec.
Wheat ...	32	33	61	69	68	67
Barley ...	17	27	107	103	89	76
Oats	36	30	38	47	45	37
Fat cattle ...	48	49	54	48	47	44
Fat sheep ...	81	72	100	93	90	84
Fat pigs ...	94	43	39	40	45	49
Dairy cows ...	72	†	59	62	60	55
Store cattle ...	28	†	38	41	36	37
Store sheep ...	83	†	130	112	94	85
Store pigs ...	151	†	29	29	33	38
Eggs... ...	63	86	71	89	84	51
Poultry ...	86	77	75	67	58	64
Milk	90	90	58	81	82	82
Butter	73	68	72	73	74	73
Cheese ...	60	71	42	39	38	51
Potatoes ...	7	91	99	154	168	166
Hay	47	0	8	-3*	1	2

* Decrease. † Many store markets closed on account of foot-and-mouth disease.

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FARM WORKERS' BUDGETS.

A. W. ASHBY,
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IV.—COMPARISON OF BUDGET INQUIRIES, 1924.

ALTHOUGH the results of the two sets of budgets which have been received this year are not wholly comparable, some of them can be fairly compared. In April last a group of budgets was collected by the N.U.A.W.* After these budgets had been closely examined some 49 were tabulated, but nine did not contain particulars of the families to which they applied. In March and April an attempt to collect budgets was made from Oxford. Forty-three returns were obtained and all these contained particulars of the families. They were indeed remarkable for the evidence they showed of willingness to give information and, on the whole, of care in making statements.

This comparison is limited to the results for 40 families in the earlier returns and those of the 43 families of the later returns. It is further limited to expenditure on items which are purchased weekly.

The number of persons per family in each of the two groups and in the combined groups was as follows:—

Table XI.—Size of Families.

	40 Budgets.		*43 Budgets.*		*Combined Groups.*	
	Total.	Per Family.	Total.	Per Family.	Total.	Per Family.
Adults (over 14 years)	85	2.125	114	2.65	199	2.397
Children	152	3.800	127	2.95	279	3.361
Total	237	5.925	241	5.60	478	5.758

In the first group the average family consisted of nearly 6 persons, equal to about 3.8 men for dietary purposes. The average size of the families in the second group was a little smaller, being only about 5½ persons, but for dietary purposes it was almost exactly equal to the other average family owing to the presence of more adults.

The average expenditure of the whole groups of families on weekly items is given below, but it will be understood that rents were not paid in all cases. For the families which actually paid rents the averages were:—40 Families Group—Rent actually paid 2s. 8d.; 43 Families Group—Rent actually paid 3s. 4d.

* National Union of Agricultural Workers.

Table XII.—Average Weekly Expenditure.

	40 Families. s. d.	43 Families. s. d.
Rent	2 1¼	2 2
Foodstuffs	18 11¾	22 5½
Cleaning Materials ...	0 10	1 4½
Insurance	0 11¾	1 9
Fuel and Light	4 5	5 3
Miscellaneous	0 3¾	1 1¼

There were considerable differences between the average family incomes in the two groups, that of the second group being the higher, but owing to lack of complete particulars for the first group it is difficult to state the exact difference. As stated in the report on the last group of budgets, the families from which they were received were in a somewhat superior position to that of the average of farm workers. The difference is partly due to the presence of a higher number of males, adults and youths, in the group of 40 families and also to higher rates of wages. This superior position is shown in the higher expenditures on all the items, including rent when the rents actually paid are taken for comparison.

With nearly six persons per family, equal to 3.8 men for dietary purposes in the first group of families the expenditure on food was 3s. 2d. per head or exactly 5s. per man. In the second group, with an average family of 5.6 persons or nearly 3.9 men the expenditure on food was 4s. per person or about 5s. 9d. per man.

As it is very probable that one group represents conditions slightly under the average and the other represents conditions slightly above the average it is permissible to combine the two groups. This has been done, with the following results:—

Table XIII.—Weekly Expenditure of 83 Families.

	Total. s. d.	Average. s. d.
Rent	178 7	2 2
Foodstuffs	1,724 9½	20 9
Cleaning Materials ...	91 5¼	1 1
Insurances, Club, &c....	114 0¾	1 4
Fuel and Light ...	403 7	4 10
Miscellaneous	61 4	0 9

The average size of families in both groups was 2.397 adults (over 14 years) and 3.361 children, being equal to 3.85 men for dietary purposes. The average expenditure on food was 3s. 7¼d. per head, or a little over 5s. 4½d. per man.

Families with more than Three Children.—For the analysis of the results of both groups of budgets they were divided into two sub-groups in which the families showed respectively more than three children or three or less than three children per

family. These results for both of these sub-groups can be shown separately.

The size of the families in the sub-groups having more than three children per family was :—

Table XIV.—Size of Families.

	22 Families.		*18 Families.*		*Combined Sub-Groups*	
	Total.	Per Family.	Total.	Per Family.	Total.	Per Family.
Adults (Over 14 years)	49	2.23	51	2.83	100	2.50
Children	106	4.82	91	5.06	197	4.925
Total	155	7.05	142	7.89	297	7.425

The average expenditures in these two sub-groups were as given below, but the actual rents of the cottages which were paid for averaged 2s. 10½d. for the first sub-group and 3s. 2¼d. for the second.

Table XV.—Average Weekly Expenditure.

	22 Families. s. d.		*18 Families.* s. d.
Rent	2 0¼	...	1 7
Foodstuffs ...	20 0½	...	25 3¼
Cleaning Materials	10½	...	1 3
Insurances ...	10¾	...	1 9¼
Fuel and Light ...	4 6½	...	4 11½
Miscellaneous ...	4	...	1 2¼

Combining all the results for the families with more than three children the following totals and averages are obtained. The cottages for which rents were paid numbered 27 with an average of actual rent of 2s. 8¾d. per week.

Table XVI.—Weekly Expenditure of 40 Families having more than 3 Children.

	Total.		*Average.*
Rent	73 9	...	10
Foodstuffs ...	895 7¾	...	22 4¾
Cleaning Materials	41 9¾	...	1 0½
Insurances ...	49 3¼	..	1 3½
Fuel and Light ...	189 0¼	...	4 ¾
Miscellaneous ...	28 8	...	8½

With regard to foodstuffs this gives an average expenditure of 3s. 0¼d. per head or about 5s. 1d. per man. On all items of expenditure except rent those of the second sub-group are higher than for the first. This is made possible by higher family incomes, largely due to the presence of more males over 14 years of age in the second group.

Families with Three Children or under.—In the budgets collected and analysed in the earlier inquiry there were 18 families with fewer than three children and in the later budgets there were 25 families of this size. The particulars for each of these sub-groups, with those for the combined groups were :—

Table XVII.—Size of Families.

	18 Families. Total.	18 Families. Per Family.	25 Families. Total.	25 Families. Per Family.	Combined Sub-Groups. Total.	Combined Sub-Groups. Per Family.
Adults (Over 14 years)	36	2.00	63	2.52	99	2.30
Children	46.	2.55	36	1.44	82	1.91
Total	82	4.55	99	3.96	181	4.21

Of the families in the first sub-group 14 paid rent, which averaged 2s. 10d. per cottage, and in the second sub-group 19 families paid rent averaging 3s. 5d. per cottage. The following is a comparison of the items of weekly expenditure in these groups, together with the combined average :—

Table XVIII.—Average Weekly Expenditure.

	18 Families. s.	d.	25 Families. s.	d.	Total and Average Expenditure of 43 Families with 3 Children or under. Total. s	d.	Average. s.	d.
Rent	2	3	1	7	104	10	2	5¼
Foodstuffs ...	17	8½	20	5	829	2½	19	3
Cleaning Materials		9½	1	5	49	5¼	1	1¾
Insurances ...	1	1	1	8¾	62	8½	1	5½
Fuel and Light ...	4	3¾	5	5¼	214	6¾	5	0
Miscellaneous ...		3¾	1	1	32	8		9

The average size of families in the two groups was 2.30 adults (over 14 years) and 1.91 children, and was equivalent to 3.022 men. The average expenditure on food was 4s. 7d. per head or 6s. 4½d. per man.

The expenditure on foodstuffs here shown is significant, for it enforces the generally known fact that the families containing the larger numbers of children suffer to some extent in the matter of diet. The comparison of expenditure on foodstuffs in the smaller and larger families is striking.

	Three Children or under. s.	d.	More than three Children. s.	d.
Total	19	3	22	4¾
Per head	4	7	3	0¼
Per "man"	6	4½	5	1

On the important point of the extent to which the foodstuffs obtained meet the dietetic requirements of the families no statement can be made, for in the later collection no attempt was made to get a description of foods, while in the former collection cash cost of foodstuffs was more generally given without weights. These separate groups of budgets illustrate the difficulty of obtaining a representative group of families, but they still yield information which is of value. On the more important items of foodstuffs and fuel it is probable that the combined groups of 83 budgets yield results which are fairly representative of expenditure of farm workers' families in the early part of 1924.

THE NATIONAL MILK PUBLICITY COUNCIL.

A. D. ALLEN, O.B.E.,
Organiser of the Council.

IT is only since the war that those interested in the milk industry in this country have awakened to the fact that a product like milk can command its own market if the consumer be encouraged to realise its value. A little investigation of international statistics showed clearly that there was enormous scope for popularising the consumption of fresh milk. Where Sweden consumed a gallon and a half this country consumed only a quart, and where America consumed a gallon this country consumed only a pint to a quart. America proved satisfactorily that the high and steadily increasing consumption of fresh milk over there was due in large measure to the work of milk publicity campaigns, and, profiting by this example, the British retailer and producer brought into being the National Milk Publicity Council of England and Wales. It consists of representatives of the Society of Medical Officers of Health, the National Institute for Research in Dairying, the Sanitary Inspectors' Association and the National Clean Milk Society in association with Organisations of British Milk Producers, Manufacturers and Distributors.

Objects.—The aims of the Council are twofold—to encourage the consumption of fresh liquid milk in this country by means of educational propaganda, publicity and press advertising, and to ensure the purity and good quality of that milk as delivered to the consumer. It is obvious that an increase in the consumption of fresh milk must benefit the producer, the distributor and the consumer alike. For the dairy farmer it solves the problem of utilising surplus milk, which otherwise must be sold less profitably for conversion into products; for the distributor it means increased sales and profits; and to the consumer it brings health, physique and eventually a cheaper article. In order to popularise milk, however, it is essential to win the confidence of the public and to overcome its indifference, and this brings us to the second aim of the Council. Before any startling progress can be made the cleanliness and good quality of the milk supplied to the customer must be guaranteed, and this guarantee the Council endeavours to secure. The health and education authorities throughout the country are not only in agreement with both these objects, but are lending active assistance to the Council's propaganda work. Representatives

from the Ministries of Agriculture and Health often attend the meetings of the Council, and the Board of Education have intimated that they are always prepared to send a representative to Council meetings if anything affecting their department is to be discussed.

The funds necessary for the carrying on of the work are being found by dairy farmers and retailers alike, and it is encouraging to note that, while in May, 1923, the income was £300 per month, to-day it is over £2,000, although the amount of the subscription has been reduced by one-half. The contribution now stands at one twenty-fourth of a penny per gallon, the distributor deducting that amount from the price paid to the producer, adding $\frac{1}{24}$d. for himself and sending $\frac{1}{12}$d. for the whole contribution to the Council. Over 10,000 producers with their respective distributors subscribe to the activities of the Council, and as the number is steadily increasing it is confidently hoped that within a short period the Council will be truly representative of all engaged in the milk industry.

Educational Propaganda.—Early in the life of the Council an attempt was made to achieve results by extensive press advertising. This was far from being a failure—undoubtedly this form of propaganda will prove thoroughly useful at a later date—but it was expensive, and after due consideration of the sums involved in comparison with the returns it was decided to limit such advertising until funds were more plentiful and to concentrate on educational propaganda. To this end a staff of carefully-trained lecturers was engaged, and special campaigns were launched in various parts of the country. The first was held at Bristol. There the public health authorities rendered the utmost support, and at the close of a month's meetings, lectures and demonstrations, the local authorities pressed for more. The practical side of the campaign was particularly appreciated, especially clean milk demonstrations for farmers. Lectures were given to various societies, public meetings were held and demonstrations and talks on milk were given in factories, welfare centres and kindred institutions. The work was highly successful, and campaigns of a similar nature were opened immediately afterwards at Eastbourne and Leeds.

A new departure was made at Eastbourne by obtaining access to elementary schools and there demonstrating to the children the value of fresh milk. The effect of this direct appeal to the children was felt almost at once, and such educational work in schools now forms an intrinsic part of every campaign. At

the request of the Medical Officers of Health in the areas, with the concurrence of the County Councils concerned, further campaigns were carried out in Gloucester and Shropshire. In all these districts the local press assisted the Council greatly by publishing reports of meetings and drawing the attention of the public to lectures and demonstrations. The letters received at the central offices from school teachers and others, praising the work of our lecturers and asking that periodic campaigns of this description might be held in their counties, show that far-reaching results may be obtained by these methods.

Although the country campaigns above referred to were highly successful, it was felt during 1924 that the main attack should be made upon the great industrial centres, and consequently the Council decided in the autumn to concentrate first upon London, taking it borough by borough. Wandsworth was chosen as a starting-point, and lectures, demonstrations and meetings were held and are still in progress. The London County Council was approached to grant permission for lectures to be given in schools, and it is gratifying to know that while unable to allow the Council's lecturers direct access to the children, the London County Council have agreed to utilise in schools the propaganda prepared by the Council and to make arrangements for their lecturers to meet and instruct the teachers. In this way through the children it is anticipated that at least half-a-million homes will be reached. Special appeals will be made to mothers and housewives to encourage the "milk habit" in the home, and intensive efforts will be made by means of poster advertising, milk weeks, postal campaigns and demonstrations at children's welfare centres to arouse the interest of the home caterer all over London in the value of milk as a food. It is chiefly by such educational methods that the Council hopes to achieve its ends, and the greatest efforts will be directed towards educating the growing generation in the constant and proper use and care of milk. The child of to-day is the parent of to-morrow, and if it can once be convincingly demonstrated to the child's intelligence that milk is the best food to have then he will grow up with that knowledge and will demand fresh milk both now and in the future.

It is difficult, of course, to quote definite facts to show the effects of all this work, but from figures supplied by the railway companies we are able to state that during the past twelve months, as compared with the previous twelve months, the amount of fresh milk carried by the railways to the metropolitan area

for consumption only, has increased by approximately 12½ per cent. The inference to be drawn from such figures is reinforced by the testimony of many business men. One factory owner in the metropolitan area writes: "The consumption of milk at our factory has exactly doubled since your lecturer gave his lecture on Friday last."

The interest shown in the work of milk publicity by other organisations concerned in social welfare, has been most inspiring. To quote but one example, the Brotherhood movement has given every encouragement to the propaganda, and our lecturers have talked of and demonstrated the value of fresh milk to hundreds of brotherhood and sisterhood meetings all over the kingdom. It is felt, and rightly too, by these friendly associations that milk consumption is not a problem for the farmer and dairyman alone. It is rather a national matter, since it deeply concerns the bodily welfare and health of the citizen.

Conferences between public health authorities, producers, distributors, and the general public have already taken place in many of the larger provincial towns, and more of them are being arranged. The Council is always prepared to send speakers to address such meetings, or indeed to address any meeting called for the purpose of considering the value of milk as a food in any of its aspects. Every effort is made by the Council to comply with requests from health authorities for lectures and demonstrations at exhibitions and similar functions, and much valuable publicity has resulted from poster displays and films on these occasions.

Demonstrations with Children.—One of the most effective methods of drawing the attention of the public to the subject was discovered in 1923, when a demonstration was conducted in the City of Birmingham on the value of adding to the diet of school children an extra daily ration of milk. The children selected for the demonstration were those suffering from malnutrition alone and not from any active disease. As far as possible they were chosen from standard families, that is to say, from families in approximately the same social circumstances. Each child was given a pint of milk daily to drink during a period of four months, and careful observation was made of the resulting development. The experiments were duly controlled and scientifically conducted, and the results were so surprising that practically every paper in the country commented upon the report when it was issued. Twenty thousand copies of this report alone were circulated to medical officers and others by

request, and so strong was the feeling expressed in other towns on the value of the experiment that similar demonstrations were arranged to take place in Blackburn, Bridgend, Leighton Buzzard and Merthyr Tydvil.

At the time of writing the Blackburn demonstration has just been concluded, and a report has been published by the Assistant Medical Officer of Health for Blackburn. The facts recorded and the conclusions drawn are less striking than those noted at Birmingham, though a definite and material increase in the well-being and health of the under-nourished children is one of the findings. The report is likely to prove less popular than the Birmingham report among the general public or the industry, but, on that very score, will probably attract greater attention from medical practitioners. As a contemporary puts it: "The author does not try to draw conclusions from his experiment beyond what the facts warrant, and he is fully alive to all the many factors which make it so difficult to draw unquestionable conclusions from physiological experiments. The modesty of the claims and the narrow numerical margins on which they are based—label the report an honest piece of work deserving of study by the author's colleagues in the medical profession. It is only by patient work of the type exemplified by this report that those who still disparage milk can be silenced."

British Empire Exhibition, 1924.—A unique opportunity for advertising the value of milk was afforded to the Council last summer by the British Empire Exhibition at Wembley. The Council undertook to be responsible for the erection of a building in which should be illustrated the dairy industry of this country in all its phases, provided that certain financial assistance in the way of a free grant of the ground necessary was given by the Government. The co-operation of the Ministry of Agriculture with the Council on this matter was immensely appreciated as, acting on the strong representations of the former, the Government acceded to the Council's request and granted the ground. The building was erected in due course by the National Milk Publicity Council, while the National Federation of Dairymen's Associations made itself responsible for the equipment of a model working dairy to be installed in the building. The intention was to make this exhibit one of educational value to all attending the exhibition, and there can be no question that it fully achieved its purpose. All sections of the trade—producers, distributors and manufacturers— combined to make the exhibit a credit to the industry.

This work of the National Milk Publicity Council received the full approbation not only of the industry, but of visitors from all over the world, who, in many cases, expressed by letter their appreciation of the usefulness of the exhibit. Not the least interested were the thousands of school children who saw the model dairy in full working order. Liquid milk was always on sale for consumption, and approximately 750,000 glasses of milk were supplied to thirsty customers. The whole process of handling milk for liquid distribution from the cow to the consumer was demonstrated at Wembley, and it would appear that the quality of the milk so produced was second to none. Thanks to the British Friesian Cattle Society, who, on an adjoining piece of ground presented by the Council, maintained a herd of pedigree cows, an additional spectacle of interest was afforded to visitors. Every milking-time saw hundreds of spectators present, and the majority carefully watched each step of the progress from the cow to the counter. Other departments in the exhibit showed the manufacture of all kinds of cheeses and butter, and, again owing to the kind co-operation of the Ministry of Agriculture and the County Councils, visitors were privileged to see dairy instructresses, from all over the kingdom, manufacturing the types of cheese made in their particular counties.

The capital expense of the exhibit was of course very heavy, but the Council feel satisfied that the money thus expended gave them at least as good a return as a similar amount spent on press advertising would have done. The running expenses were more than met by the net sales, and it is hoped this year to do equally well if not better.

The British Empire Exhibition in 1925.—The Council is considering, at the moment, how to improve upon last year's exhibit, and it is probable that in the coming summer greater stress will be laid on the publicity and educational side than on the manufacturing. Whatever form the exhibit may take this year it is certain that such publicity has a stimulating effect on the milk industry, and that the public will drink milk if it is supplied to them in an attractive form and they are assured of its cleanliness.

Publicity.—One phase of milk publicity which has barely been touched upon in this article is the enormous work done by the central office in the distribution of leaflets, posters and pamphlets. As a result of our initial press advertising more than 300,000 recipe books were sent to consumers by request, and during the past twelve months hundreds of thousands of

other leaflets have been issued. An interesting booklet just produced is entitled, "About Milk," and is written by Professor Kenwood (Professor of Hygiene and Public Health in the University of London).

Nor are the possibilities of the wireless and the film neglected. Whenever possible, wireless talks are arranged and afterwards, if possible, adapted for pamphlets. Four films of educational value, showing the advantages of milk consumption and the processes of milk production have been secured by headquarters, and are largely in demand by health centres and at exhibitions. A fifth film dealing with the Council's activities at Wembley has just been completed, and is now available. Letters are received every day expressing appreciation of the different aspects of the Council's work, and one cannot fail to see that, however gradual it may be, public interest is being surely aroused on the subject of milk consumption.

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DEVON CATTLE.

C. MORRIS.

LIKE most breeds, it is difficult to settle definitely whence the Devons originated, and at what date. It is known beyond doubt that they are one of the oldest and purest breeds.

The earliest references to the breed have been collected by Mr. James Sinclair, in his "History of the Devon Breed of Cattle," published by Messrs. Vinton & Co. Some of his references are:—

"In a letter written in 1580 and preserved in the Record Office among the Irish MSS., Sir Nicholas White, Master of the Rolls in Ireland, says that Dingle Harbour in Kerry was known as 'Coon Edaf Dearg,' which in Irish means 'Red Ox Haven.' White says this name was owing to the first settlers who came from Cornwall and brought cattle with them. The native cattle were black."

Until towards the close of the 18th century, writers on farm live stock were scarce. After mentioning the description in George Culley's *Observations on Live Stock*, 2nd edition, 1794, Mr. Sinclair says:—

"Our next reference is to Arthur Young's *Annals of Agriculture*, where we find, Vol. 17, p. 303, a letter on 'Devonshire Cattle, by Paul Treby Treby, Esq., of Plympton, Devonshire,' dated October 16th, 1791. He says: 'The best breed is in the vicinity of Barnstaple, North Molton and South Molton, where rearing of cattle ever has been the chief return to the farmer;

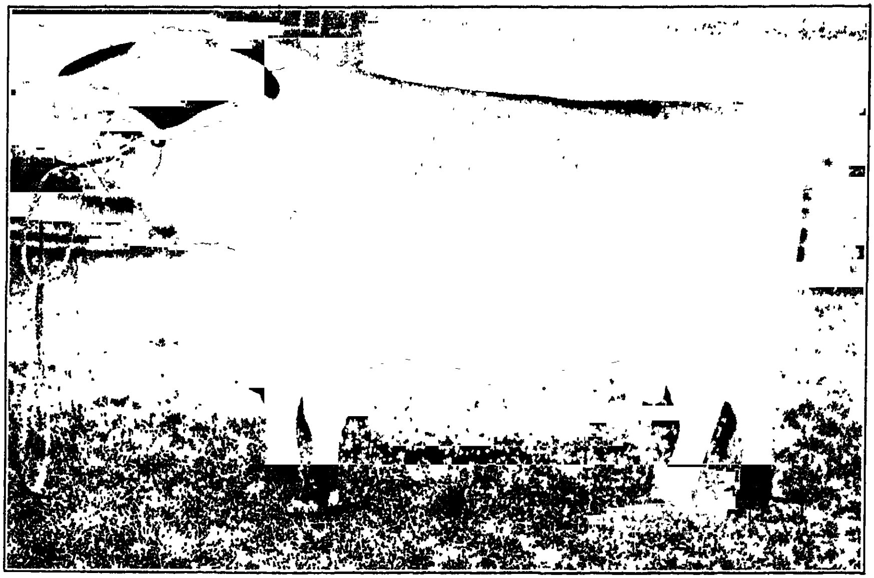

Photo.] FIG. 1.—A Devon Bull. [*Sport & General.*

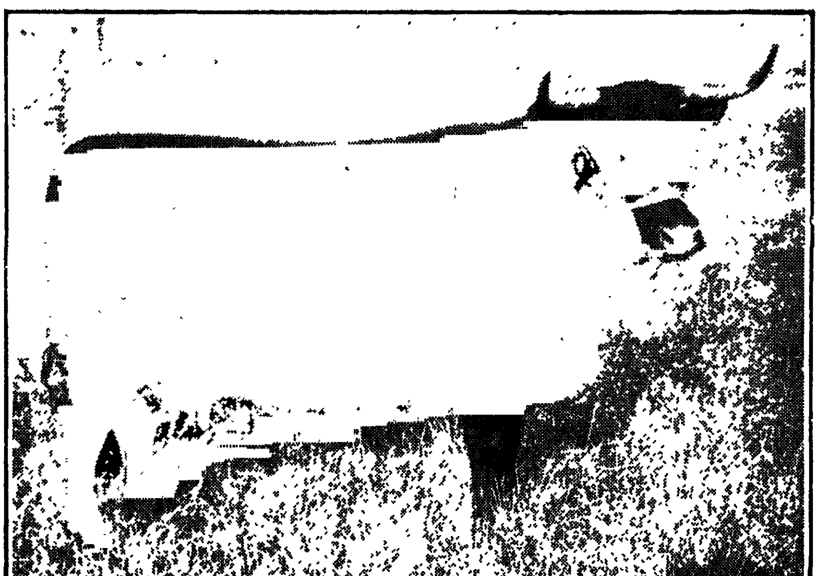

FIG. 2.—A Devon Cow, Highfield Farthing VIII.

consequently it has been their aim to get as perfect a breed as possible, and which they are still anxious to improve.'

" 'The best bullocks are of a bright red colour; round a very prominent eye a ring of bright yellow; the nose round the nostril the same colour; the neck and head small, with an upright, taper, gently curved *clear* horn (not tipped with black); their bones well proportioned; and carrying their weight in the best cuts. I have mentioned what certainly is their chief merit last; but, though the graziers may be of the same opinion, they appear not the less solicitous concerning their other peculiarities, looking on them as certain signs of good proof.'

" The History of Devonshire, by the Rev. Richard Polwhele, 1797, contains, besides the author's own observations, the notes of several local men, his correspondents, upon the subject of the North Devon breed. He says: 'Whether the breed of cattle famous in the North of Devon are indigenous or not, it is not easy to determine. There are some circumstances in the description of them which lead me to think that they are indigenæ; they are in many respects superior to any other breed in the kingdom; and those around South Molton, North Molton, and Barnstaple, excel most others in the North of Devon. These are the finest bullocks in the Smithfield market; they are a very healthy breed and easily fed, they are fleshy with small bones, and they " bear the best weight " (as Baker terms it) on the most saleable parts; they are of a cherry colour or bright red.' "

Foremost amongst the names of breeders who did so much for Devons in the last century (19th) must be the name of Mr. Francis Quartly, of Champson, Molland. The Quartly family went to North Devon from Somerset over 220 years ago, having previously been settled at Exton, a small village and parish near the main road from Dunster to Dulverton in Somerset.

Among the prominent breeders of the middle of the last century, the following names are well to the fore: Quartlys, Davey, Lord Leicester, Lord Falmouth, Hole, Risdon, several families of Gibbs and Hancocks, Joyce, Boucher, Walter Farthing, Rayer, Bucknell, Skinner, Kidner, Blake, Kittow, and Messrs. Chick.

Some of the noted animals shown between 1840 and 1890 were " 100 Guineas " and " Prettymaid " shown in 1842 by Mr. Quartly, " Duke of Flitton " shown by Mr. Davey in 1862, " Prettyface " shown by Mr. Walter Farthing in 1876, and " General Gordon " by Alfred Skinner in 1885.

Regarding early shipments of Devons abroad, it is recorded, as regards the United States, that Messrs. Winthorp and Davenport about the year 1800 imported Devons into Plymouth, Mass. In 1805, General Eaton imported some into Otsego County, New York. Of these early importations there is no further record, and for all practical purposes the first information that has been preserved is that relating to the importation of a bull and six heifers in 1817, presented by Mr. T. W. Coke (afterwards Earl of Leicester) to Mr. Robert Patterson, a celebrated merchant of the City of Baltimore, Maryland, from which many of the best American Devon herds were descended.

The first record of export to Australia is that the late Mr. Charles Reynolds, founder of the Tocal herd of Devons, who managed for his father, Mr. Thomas Reynolds of Raddon Court, Thorverton, Devon, whose herd was dispersed about the year 1839, went to New South Wales in 1840, and in 1842 commenced breeding pure Devons at Louth Park, near Maitland, on the Hunter River, by the importation in that year of the two Devon bulls, "Molland" and "Red Rover," both of which were bred by Mr. Quartly.

The first record of a pedigree Devon herd sale is of that held at Champson, by Mr. Francis Quartly, in 1836—73 head were sold, but only one bull made over £100. At Lord Falmouth's sale in 1890, 76 head averaged £61 2s. 6d.; seven made over £100, and "Blooming Heather" made £260 to Mr. Punchard.

The great demand for Devons, especially for grazing purposes, is probably due to the present-day demand being for medium-sized joints of exceptionally good quality.

A Dual-Purpose Breed.—Everyone realises what a good beef animal the Devon is, but their records as milkers are not so generally known. Many milking Devon herds exist in Dorsetshire, where the cows are let to dairymen at high prices. They do not compare in quantity with some of the special breeds, but there are many cows giving over 1,000 gallons, and cases of cows yielding 2 lb. of butter a day are recorded.

At the London Dairy Show in 1920, with an entry of 183 cows of all breeds, a Devon cow gave the highest percentage of butter fat, 6.43 per cent. In the open milk test for cows of all breeds at the Bath and West Show at Plymouth in 1922, in which South Devons, Shorthorns, Red Polls, Friesians, Jerseys, Dexters, and Devons to the number of 31 competed, the first and second prizes were won by Devon cows. The first prize

animal gave $66\frac{1}{4}$ lb. of milk in 24 hours. Many herds consist of dual-purpose cows that can bring up two calves well and give them a good start in life, and hold their own condition most satisfactorily.

Although Devons are spreading over the south of England, they are practically all bred in the south-west—Devon, Cornwall and Somerset, and the milking herds chiefly in Dorset. The geographical position is rather against them for shows held in the north or midland counties, for their breeders being largely tenant farmers, expenses have to be considered. It is, however, a good sign that the small farmers stick to this breed in the west, as they generally know which are the best rent payers.

A pamphlet recently published by the Devon Cattle Breeders' Society successfully brings out the virtues of the Devons, and anyone thinking of starting a herd would do well to read this through before settling which breed they would adopt. Devons have many advantages—beef quality of the best, constitution, and early maturity coupled with fair milking qualities, while for running in a park, whether for grazing or milking, what are more picturesque than the "Rubies."

Breeders.—Many of the old names connected with Devon breeding are well to the front now, such as Cook, the Hancocks and Kidners, Merson, Skinner, the Brents and Chicks, Hill, Williams, and Yendell. At the bull sales held in February and October, the following breeders generally have a good lot of entries, Clatworthy, Bruford, Brent, Burnell, Bussell, Skinner, the Stanburys, Williams, Cook, Huxtable, Cornish, and Pope.

Two very well-known herds have recently been dispersed: Mr. C. L. Hancock's of Cotherlstone who had a very good herd, and the farm was noted for turning out good healthy stock; the other was that of Mr. Sam Kidner, Bickley, Milverton, to whom we owe thanks for being the only living member of our Breed Society who has won the Championship at Smithfield against all breeds with a Devon.

In the last year we have lost a well-known breeder and good judge of Devon cattle, Mr. William Brent of Clampit, Callington. He was one of our most popular judges, and it is very doubtful if any herd was more consistently bred to type than his. Mr. John Risdon, a name which recalls some of the best breeders of the west, who has acted as the popular Secretary of the breed society for 40 years, retired last year.

Exhibiting.—The Devons are hardly represented at the shows as well as they should be, no doubt partly owing to the

geographical position of their home, and through having fewer wealthy exhibitors than some breeds. Exhibitors know that as a rule it costs nearly £20 to win a £5 prize at the summer breed shows, but there is no excuse for their not being better represented in the past at the Smithfield Show, where there is no return freight and the Devon exhibits realise such good prices. The Council of the Society has tackled this question, and an improvement is being made.

Sales.—I think it would be an advantage to have a good female sale once a year, at some good centre in the West of England; it would be a good opportunity for those who wanted to purchase as well as to those who had surplus stock to sell. Female sales should be on very strict lines to protect the buyers, and enable them to buy absolutely good breeders. Each cow for sale should have specified the date of birth of her last living calf, and a big percentage of the purchase money should be refunded on a female sold as in-calf which turned out not to be so. I think the sales at the summer breed stock shows are not a success; purchasers are afraid of the animals being too fat to make good breeders.

The Devon breeders are organising a special steer and heifer sale to be held yearly in the spring, and offering prizes that will bring out a good class of animals well forward for showing purposes. The sale is to be held at a town with good railway communication, so that purchasers from the southern counties can make selections for their local Christmas fat stock shows. There will be found at these sales, steers that will make up to 16 to 17 cwt. live weight, under three years old. In addition, there will be ordinary store steers, which are such favourites for grazing in the midlands owing to their constitution and early maturity, and because whenever sold in competition with other breeds, they command such favourable prices.

The Standard of Excellence.—I think the Council could take steps to alter their standard of excellence as regards the question of white. The standard provides that there should be little white in front of the udder, or at least none beyond the navel. Cows that have white up to the navel breed a large percentage of bulls that have too much white for the public demand, and cases often occur where purchasers of bulls with no white would not have given half the price if they had known the dam had white so far forward.

There is a difference of opinion about the question of colour, but within reason I like to breed Devons as dark as possible. I

find foreign buyers generally ask for the dark colours, and as animals get older or get weaker in constitution, they seem to get a lighter colour.

Export.—For export, the Devons have become great favourites in South Africa and Brazil; they are also giving great satisfaction in Australia and New Zealand. Their great asset is constitution, and ability to cater for themselves. An exceptional case was experienced in Queensland in the last big drought. There were on a ranch 60 bulls of another beef breed, and 12 Devons: at the end of the drought 58 of the other beef breed had died, and only 2 of the Devons. I have had similar information from South Africa, Uruguay, and Brazil, testifying to their strong constitution.

Unfortunately, the export trade in recent years has been practically killed through exchange and other financial difficulties, and restrictions due to foot-and-mouth disease in this country. At home the prices realised for Devons have been fairly satisfactory on the whole—no very big prices, but at the bull sales held twice a year, the averages, comparatively speaking, have kept up well.

I have made it a special point to push and advertise the Devon abroad, and was making very rapid strides until the outbreak of the war: in fact, in about 12 months in 1923 I exported 83. Since that date the difficulties of all kinds have practically killed the export business, but I think the time must soon come again when replenishing orders for ten at a time will be placed from Rhodesia, South Africa and Brazil; indeed, with all pedigree animals they will have to make up for lost ground when they do start purchasing. I have made it a point to keep in touch with many who were big purchasers before the war, and Devons certainly have proved their suitability for these three countries.

There have been very few Devons exported to the United States in recent years, but the breed has been carried on most successfully there on the milk line. I believe they de-horn them a good deal. I was sent particulars last year of the Devon cow "Wolly Dartmoor" (15,586). She started on her test 5th March, 1922, and produced in one year 14,472 lb. of milk, 601.8 lb. of butter fat.

In conclusion, it must not be forgotten, that now when the demand for early maturity is so keen, the heaviest steer under fifteen months old, at the last Smithfield Show—in competition with all breeds—was a Devon weighing 11 cwt.

THE CUTTING OF POTATO SETS.

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University of Leeds.

THERE are certainly occasions when the potato grower would be glad to cut his seed potatoes and plant the cut sets, but in practice there appear to be two grounds on which he hesitates to adopt this plan. In the first place, there is a very general impression that the yield per plant, when potatoes are grown from cut sets, is usually lower than the yield per plant grown from a whole tuber. This question admits of further examination, but is not considered further in this paper. It suffices for our purposes to point out that in very many cases this is not in any case a decisive argument against propagation from cut sets, as the assumed smaller yield per plant, under certain circumstances is of less importance than the greater yield from a given quantity of tubers which is thus undoubtedly obtained.

In the second place, there is the undoubted fact that in many potato growing areas, cut sets are not planted because of the grower's experience that there is great uncertainty as to the growth and healthy development of such sets. It is to this point that attention is directed here. We think it can be shown that there is good ground to assume that, provided certain precautions are taken, this uncertainty as to the propagation of cut sets disappears. Certain experiments carried out in various parts of England during 1923 will be analysed from this point of view. As our conclusion, if justified, would seem to be of considerable practical importance, it is hoped that further experiments will be tried by potato growers along the lines suggested below.

It is relevant to our problem to point out in advance that the varied experience of practical growers with cut potato sets, as we have received it, seems to admit of one important generalisation. In districts of high rainfall, such as some parts of Lancashire, where the potatoes are usually planted in moist earth, the practice of cutting sets is followed regularly and considerable confidence is felt in it. On the other hand, in districts of low rainfall, where the planting season frequently coincides with a dry spring, the practice is regarded with distrust and is but little adopted. In such districts the grower has recollection of some years when a favourite variety, planted after cutting to make a limited supply of valuable tubers go further, has rewarded his efforts by rows of misses so that a

considerable portion of the ground has yielded no crop at all. In the light of the considerations advanced below, it would seem possible to follow the practice of cutting where other considerations seem to make it desirable, and at the same time almost completely protect oneself against the risk of such a failure on the part of the cut sets.

In order to make our argument complete it is necessary to consider the processes that occur at the cut surface of the tuber immediately after the cut is made; it will then be possible to show the experimental basis upon which the conclusion is reached that, if tubers are cut in a certain manner, they can be planted with as much confidence as whole tubers.

The Natural Healing of a Cut Potato Tuber.—Like all other living plant tissues, a potato is a compact mass of tiny living units, the plant cells, which are capable of displaying great activity under appropriate conditions. In the whole tuber these living cells are protected from outside influence by the corky skin consisting of many regular rows of flattened cells, which are dead and empty but have their walls so impregnated with a fatty varnish-like deposit that they keep soil water from percolating in amongst the living cells. These cells also render the loss of water vapour from the living cells inside very slow, if the potato is stored under dry conditions or is lying in dry soil. This tough, corky skin is also responsible for the fact that the numerous organisms in the soil which thrive on dead organic matter, fail to thrive upon the rich organic store of the tissues within the tuber. Thus a few of the living cells within the tuber are illustrated in Fig. 1. If they were not protected by the corky skin (*c*, Fig. 1) various moulds and bacteria of the soil would be able to grow upon and digest the cell-walls (*c w*, Fig. 1) of the living cells, which mainly consist of carbohydrates; this would happen even though the starch grains within the cell were protected from attack for a time by the fact that they are enclosed within the living protoplasmic layer (*p*, Fig. 1) which lies just within the cellulose wall of any living cell.

These moulds and bacteria, however, are quite unable to attack the stores of food in the inner wall, because they can neither pierce the cells of the skin by force, nor digest their way in, being unable to digest the fatty substances in the corky walls, which are akin in nature to the varnishes formed by drying oils such as linseed oil, when these oils are allowed to

dry upon a wood floor. (It is, of course, an everyday experience that such a varnish, when once dried in, keeps the timber from getting soaked with moisture and from rotting readily under fungus attacks.) It is true that in the corky skin there are natural holes, places where gas exchange goes on between the air spaces inside the tuber and the soil, a necessary feature because the living cells within the skin must breathe. The protection of these breathing pores against the entry of the various organisms of the soil is but little understood, and it is perhaps worth noting that the protection is by no means complete, and that the entry of various organisms which produce disease in living potatoes can be traced to penetration through their breathing pores—named lenticels by the botanist.

If one's imagination will then picture the complexity of structure of a living tuber, it will be realised that the act of cutting across it with a knife may be compared to the cleavage with a spade of an anthill during the winter's repose of its denizens. When the knife cleaves through the skin and shears through the living tissue, leaving a number of crushed and dying cells along the cut surface, the outside air obtains free entry to numbers of tiny corridors ramifying in all directions between the living cells, along which, previously, air movement had been but a slow gaseous diffusion.

Now when the outside air is thus brought in sudden direct contact with the living cells, close to the cut surface, it will make a very great difference whether this air is dry or damp.

If the air is damp, the living cells containing sugar, and starch from which more sugar is readily formed, will absorb water from the air, and, as they become turgid, will let some of their sap ooze out into the walls. The result is that in the cut potato there is very shortly an ooze of sap, percolating along the walls between the living cells, so that just below the dead and dying cells at the surface there is a colony of living cells, with walls of cellulose, that is to say of very much the same substance as blotting paper, which are saturated with sap. The sap thus diffusing in the wall, like a drop of liquid spreading in blotting paper, is not pure water but a solution of various substances, and one most important substance is a fatty substance with "drying" qualities—*i.e.*, in contact with air it tends to set to a varnish. As this substance comes in contact with the outside air at the cut surface, therefore, it tends to deposit in the wall as an insoluble firm deposit, similar in nature to

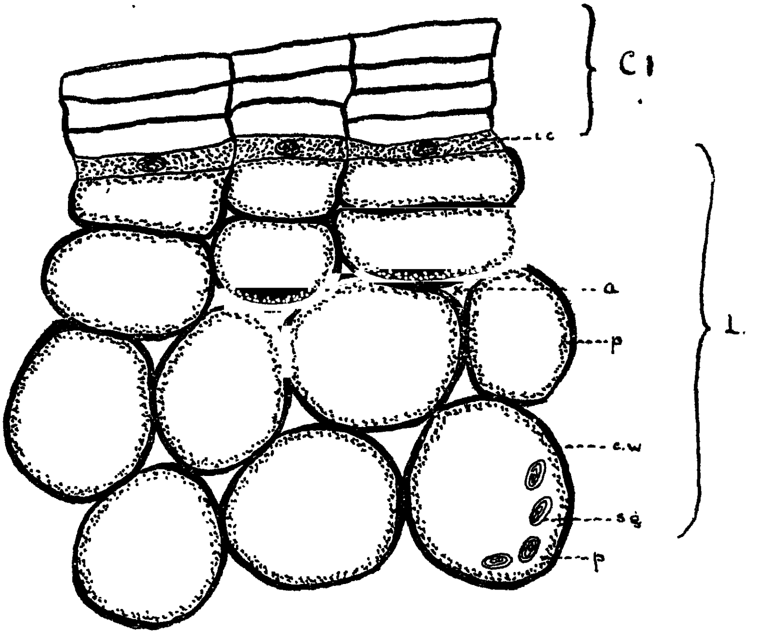

FIG. 1.—Cells of the Potato under the microscope.
c. Layer of Cork Cells forming Skin, all except the innermost layer, i.e., empty of living contents.
l. Living Cells within the Skin.
c.w. Cell Wall. *a.* Air Space. *p.* Living Layer of protoplasm just within the cell wall and enclosing the starch grains, *s.g.*

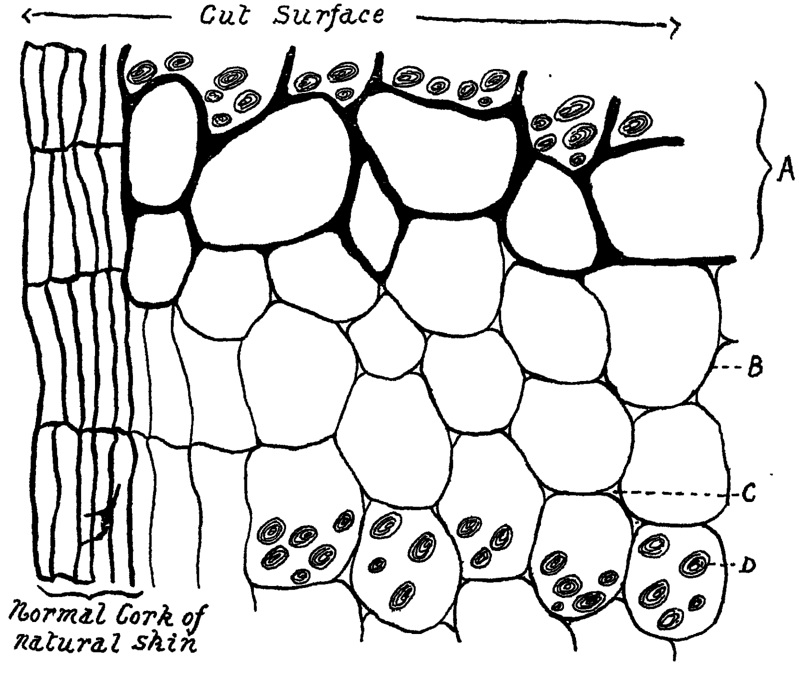

FIG. 2.—Section through Cut Potato showing—
A. Cells with Suberin deposited on their walls in a continuous layer.
B. Walls without Suberin, but Cells have lost their starch contents.
C. Air Space.

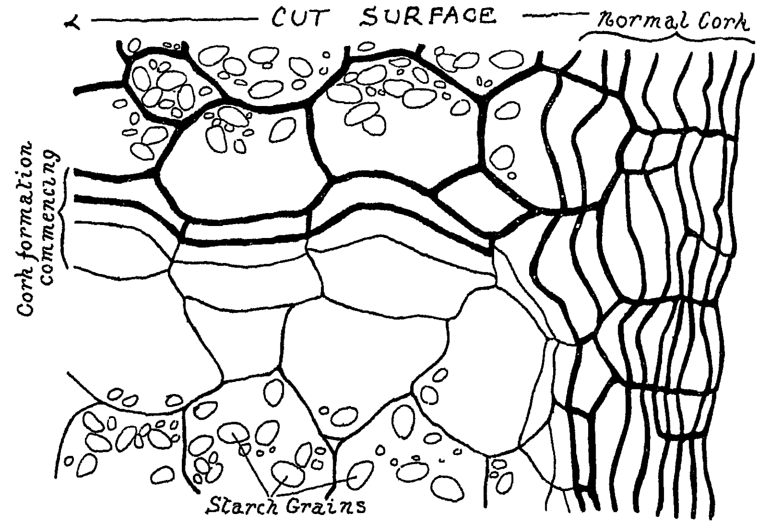

FIG. 3.—Section through Cut Potato showing New Protective Cork Formation commencing.

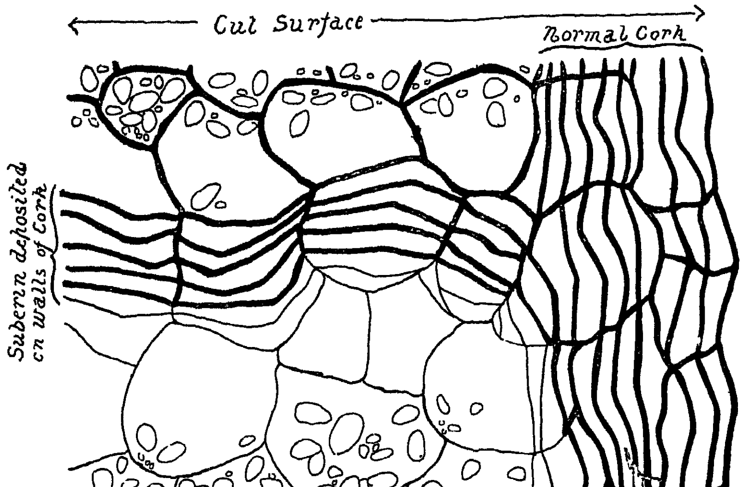

FIG. 4.—Section through Cut Potato showing New Protective Cork Formation completed.

that present in the cork walls of the normal skin. Such a deposit is known as a suberin deposit; its formation is of great practical significance, because, as the cut surface dries in the air, this fatty substance oxidises to a suberin layer, which, in the potato cut in moist air, tends to form a continuous layer below the dead cells at the cut surface, cutting off completely the living tissue within from the organisms in the soil capable of living upon their walls (Fig. 2).

On the other hand, if the potato is cut in dry air and left in dry air, less water is absorbed by the living cells than sap released into the walls, the deposit of suberin is patchy and not continuous, and when the cut set is planted, it seems to remain patchy for a long time, and between the patches the soil organisms penetrate, disintegrating the tissue of the potato as they grow upon the walls. If the potato is cut and exposed not merely in dry air but in sunlight, this patchy production of suberin is much more marked, and the potato remains far more open to the entry of these organisms subsequently.

When once this original suberin deposit is formed at the cut surface (and it forms in a period of from 12 to 48 hours) the cells just below the cut still remain active, the starch in them is digested, and below the suberin deposit some cells grow and multiply to give a new protective cork layer, as indicated in Figs. 3 and 4, but if the original suberin deposit is patchy, the subsequent cork layer is also irregular, and through the breaks in this natural protective layer the various organisms enter.

A most simple experiment will convince anyone how important the condition of cutting and exposure of a cut set may be to its subsequent fate. If several potatoes are cut across on a sunny day and the one half of each potato is left in the sun, and the other placed in a damp box protected from the sun for some five or six hours, and then subsequently the two halves are placed *side by side* in a damp place, inspection in a few weeks will show all the cut halves which were exposed to sunlight and dry air to be the prey of all sorts of fungi. On the other hand, the cut surface which was left throughout in moist air will be found smooth and clean. In our experience this experiment has never been known to fail, and provides a most striking demonstration of the importance of the conditions under which the tuber is cut and left. The scientific problems involved in this natural process of healing are discussed more

fully, but in a more technical manner, in a recent paper in the *Annals of Applied Biology*, Vol. X, pp. 96 to 115; it is now necessary to try and estimate the practical significance of these observations.

Field Experiments with Cut Sets.—Potatoes cut in moist air and not exposed to the sun have now frequently been kept for months, the cut surface remaining clean and showing no more tendency to the growth of mould than the normal skin. On the other hand, if the cut surface has been left for a few hours under dry conditions, especially when exposed to the sun, the cut surface is covered with a growth of moulds. These moulds are very varied in character, and usually of the type known as saprophytes, that is to say, they are regarded as dependent upon dead organic matter for their supply of food. But, as the walls between the living cells disintegrate under their attack, the isolated cells lose their vitality and succumb also, and in course of time pathogenic organisms, capable of destroying living tissue, make their appearance. We have now to ask what practical effect the difference in the condition of the healed surface will produce upon the germination of the cut sets when planted, and the yield of tubers obtained from them. It is important to realise that the growth of the organisms upon the cut surface so long as they are saprophytic in character, is very slow, and that decay does not spread rapidly throughout the tuber.

In so far as it proceeds it is clear that food and nourishment, originally available for the young potato plant, is being withdrawn and utilised in the growth of these moulds. There is, however, in a cut set, as in a whole tuber, an excess of food available for the young plant, and frequently when growth in the early stage is not vigorous, the plant will fail to utilise all the reserves of the seed tuber or cut set before it is again storing up food below ground in a new crop of tubers. The grower recognises that this is a fault in the plant's development and that when the seed tuber remains unutilised in this manner, it means that growth has not been so vigorous as it might have been, and the consequent yield from the plant is smaller than it need be. It is in this sense that the complete disappearance of the seed set, *as a result of the complete withdrawal of its food reserves into the growing plant*, is regarded as an indication of satisfactory growth.

It is quite another story if the set disappears early in growth, because the food reserves are dispersed by the activities of

FIG. 5.—Section through Cut Potato showing Formation and non-Formation of Callus.

saprophytic and parasitic moulds, rather than because they are drawn into the growing plant. If this happens early in germination, insufficient food may be left for the young plant's early growth, until its own leaf activity can maintain the food supply. In this case, the result is complete failure of the plant —a "miss." Even if this is not the case, the poor growth in the early stage is likely to be reflected in a small yield when the crop is harvested.

The general conclusion is, therefore, that where the growth of the potato plant is slow, as it will be in a dry spring, if the cut surface is entered by mould and other organisms, as is almost certain to be the case if cut under dry conditions and exposed to sunlight, then the cut sets are likely to fail entirely, or give a poor yield. On the other hand, where cut sets are planted in damp soil in a warm spring, and make vigorous growth early, even if moulds are robbing the plant of reserves through the cut surfaces, the probability is that so much food will be mobilised early for the plant's own use that the practical significance of loss through the cut surface will be negligible.

We have now a standpoint from which it is possible to examine the experiments carried out to test the effect of different conditions of cutting upon sets.

Experiments in 1921 *and* 1922.—Experiments were carried out in 1921 and 1922 at Bentley Road Council School, Doncaster. The garden, the soil of which is a good sandy loam 10-12 in. deep, overlying gravel, had been well cultivated for a number of years. During the time the experiments were being carried out, well-rotted manure from a slaughter-house was used at the rate of 15 tons per acre. In addition to this, a dressing of complete artificial manure was applied, before earthing up the rows, at the rate of 4 cwt. per acre. The soil was dug spade deep and the manure placed in the bottom of the trenches. The potatoes were then planted on top of the manure as each trench was prepared. A dressing of chalk was applied in March, 1921, to the whole garden.

In 1921, the experiments were carried out with the variety Great Scot, and in 1922 with Great Scot and Edzell Blue. In most of the experiments the tubers used as "seed" were medium sized ware. Each tuber was cut into two sets and then given one of the two following treatments:—

(*a*) Cut and exposed to sun and air for a period of 24 or 48 hours.

(*b*) Cut and kept in a damp, warm, shaded place for a period of 24 or 48 hours.

Relevant data from these experiments are given in Tables I, II and III.

TABLE I (1921).

Planted 9th April.
Lifted 1st October.
Variety Great Scot.

Ware potatoes used on each plot.

Weight in tons per acre.

Plot No.	*Treatment of Sets.*	*Ware.*	*Seed.*	*Chats.*	*Total.*
I.	Cut into two sets and planted at once.	9.96	2.88	0.65	13.49
II.	Cut into two sets and then exposed to sun and drying air for 24 hours.	6.47	0.60	1.01	8.08
III.	Cut into two sets and kept in damp, warm place for 24 hours.	15.78	1.41	1.46	18.65
IV.	Planted whole	9.86	3.03	1.46	14.35

All sets used were "once grown" at Garforth.
On Plot I the sets were cut on 9th April and planted immediately.
On Plots II and III the sets were prepared on 8th April. A cold frame was well damped down and the lights put on and closed. Pea sticks were placed on the top of the lights to shade slightly. The potatoes were then cut into two. Those for Plot II were placed outside the frame, and those for Plot III inside the frame.

TABLE II (1922).

Planted 16th May.
Lifted 3rd October.
Variety Great Scot.

Weight in tons per acre.

Plot No.	*Treatment of Sets.*	*Ware and Seed.*	*Chats and Diseased.*	*Total.*
I.	Ware Sets. Cut into two sets and planted at once. O.G.*	15.27	1.94	17.21
II.	Ware Sets. Cut into two sets and exposed to sun and drying air for 48 hours. O.G.	14.14	1.57	15.71
III.	Ware Sets. Cut into two sets and kept in a damp, warm, shaded place for 48 hours. O.G.	16.05	1.38	17.43
IV.	Ware Sets. Planted whole. O.G. ...	20.01	2.75	22.76
V.	"Seed" Size. Cut each into five sets, bearing one eye each, exposed to sun and drying air for 48 hours. S.S.†	9.07	0.40	9.47
VI.	"Seed" Size. Cut each into five sets, bearing one eye each. Kept in a damp, warm, shaded place for 48 hours. S.S.	13.12	1.09	14.21
VII.	Ware Sets. Cut into two sets and exposed to sun and drying air for 48 hours. S.S.	14.58	1.57	16.15
VIII.	Ware Sets. Cut into two sets and kept in damp, warm, shaded place for 48 hours. S.S.	23.65	1.45	25.10

*O.G. Once grown at Garforth.
†S.S. Scotch Seed.
Exposed and non-exposed sets treated as for 1921.

Unfortunately, some of the plants of Plots II and III were killed by Blackleg (*B. atrosepticus* van Hall) and this has not been allowed for in working out the quantities per acre.

In the control plot, No. IV, the whole sets gave a larger crop than those cut and planted at once. It will be noted that the difference in yield in favour of "protected sets" from Great Scot is greater in the 1921 experiments than in the 1922. It is probably of significance in this connection that the weather after planting in 1921 was very dry, whilst in 1922, on the contrary, the plants developed in a normally wet season.

The following experimental results were obtained with Edzell Blue. Each row in the plot contained six sets of each type, sixteen rows being planted in all. At intervals, one plant of each type was lifted, the growth and condition of the two types being noted and compared. Photographs were also taken. The remainder of the plants in the plot were left until the crop was almost mature and the results in tons per acre are given in Table III, showing a gain of 5.8 tons per acre in favour of the plants grown from sets not exposed to sun and dry air.

TABLE III (1923).

Planted 16th May. *Lifted 23rd August.* *Variety Edzell Blue.*	*Total crop in tons per acre.*
Seed size. Cut into two sets, and kept for two days in a damp, warm, shaded place. Once grown.	13.31
Seed size size. Cut into two sets, and exposed for two days to sun and air. Once grown.	7.43*

When the plants were lifted at intervals a very striking difference was visible in the cut surface of the sets. Smooth and firm in the sets cut in the shade, in the other sets the surface was pitted and broken. This difference is clearly shown in Fig. 5, in which the cut sets are shown freshly cut at right angles to the original cut.

Experiments in 1923.—During 1923 the experiments were continued at Garforth, three varieties of potatoes being used, namely, Bishop, King Edward and Majestic. In this set of experiments the time of exposure and non-exposure was cut down considerably, with the idea of proving that the difference in weight of the crop between exposed and non-exposed sets, obtained in previous years, was due to the continued effect of dry air and sun.

* 20 sets failed to appear above ground, having apparently been killed as a result of the 48 hours' exposure.

The sets were cut on the afternoon of 7th May, and the exposed sets placed in sun and air for two hours (2-4 p.m.). They were then removed to a shed for the night. The non-exposed sets were placed in a cold frame at 2 p.m. and left until the following morning. All sets were planted on the 8th May.

As was to be expected the healing of the cut sets was not hindered to any appreciable extent by two hours' exposure, and the resulting crops showed little difference in weight when compared with the non-exposed crops.

Weather conditions after planting were not favourable to growth. The soil was cold and wet, and remained wet until the plants were above ground. There were no misses on any of the plots. The results are given in Table IV.

TABLE IV.

Bishop, Scotch Seed. 2 oz. sets approx.	*Weight of seed planted per acre. Tons per acre.*	*Total crop. Tons per acre.*
1. Whole sets	1.10	13.46
2. Cut and exposed	0.55	10.68
3. Cut and not exposed	0.55	11.13
King Edward, S. Seed.		
1. Whole sets	0.71	7.76
2. Cut and exposed	0.35	5.17
3. Cut and not exposed	0.35	5.11
Majestic, S. Seed.		
1. Whole sets	0.67	6.74
2. Cut and exposed	0.38	4.66
3. Cut and not exposed	0.38	5.70

Through the co-operation of the Ministry of Agriculture and various Local Authorities in England and Wales, it has been possible to give the practical problem of the conditions of cutting potato sets a wider trial in 1923, and in the following Tables all relevant results obtained from various centres are included.

In Cumberland small experiments with three varieties were carried out at a number of centres. At each centre ten whole sets were planted, ten cut sets that had been exposed, and ten cut sets that had been protected from drying. The average results for each variety and the number of centres at which each was tried are given in the following table:—

Variety.	*No. of Centres.*	*Whole Sets.*	*Cut and Exposed Sets.*	*Cut and Protected Sets.*
		lb. oz.	lb. oz.	lb. oz.
King Edward ...	9	14.10	7.11	11.14
Bishop	12	17. 6	13. 2	13.14
Majestic	12	16.12	13. 3	15.12

In five other counties ten sets of each kind were planted at one centre in each county, and in two other counties 25 and 17 sets respectively were planted. The results are summarised below. A number of varieties were planted so that at each centre from 30 to 75 whole sets were compared with the same numbers of the two kinds of cut sets :—

County.	*No. of Variety.*	*Yield from whole Sets.*	*Yield from Cut and Exposed Sets.*	*Yield from Cut and Dried Sets.*
		lb. oz.	lb. oz.	lb. oz.
Denbigh	3	23.11	20.13	17. 8
Lincs	3	21. 7	19. 7	19. 7
Anglesey	3	14.10	11. 7	11. 3
Brecon and Radnor	3	26. 0	18. 5	24. 5
Glamorgan	3	6.11	4. 5	7.11
West Sussex ...	3	17.11	11.11	18.11
Cardigan	4	13.11	12. 6	14.14
Average of Centres	—	17.11	14. 1	16. 4

A brief review of these data shows that, with few exceptions, sets cut and kept protected from sun and drying wind, have given better yields than sets cut and left exposed for a few hours in sun and dry air; there are, however, no experiments which suggest that sets cut and so protected are more liable to misses than whole sets.

On the other hand, sets left in dry condition frequently show a high proportion of misses, and in some cases, when they do so, the yield per plant in cases where growth takes place is lower than the yield per plant from cut protected sets.

On the whole, examination of these experimental results strongly supports the conclusion reached previously on other grounds, that quite apart from yield, the certainty of growth from cut sets is much greater if precautions are taken as to how the sets are cut and left before planting.

It is hoped that at different centres throughout the country the efficacy of protection against dry air and sunlight will be further tested during 1925. In view of the fact that yields may only be affected when the development of the young plants is slow, details as to weather condition at the time of cutting and planting, and for the first few weeks of growth, would be of value in the records of such experiments, as also would records of " misses " and of other comparative observations on the time of appearance of the plants and the condition of the cut sets at different dates after planting.

THE DEVELOPMENT OF AGRICULTURAL EDUCATION IN EAST SUSSEX.

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SYSTEMATIC instruction in agricultural subjects was commenced in East Sussex in 1891, and appears to have been originated by a number of progressive members of the Technical Instruction Act Committee of the County Council. This Committee dealt with a variety of subjects, and as many of the members were prominent agriculturists, it was natural that their thoughts tended towards instruction in agriculture and its allied subjects. It should be remembered that at that time an education rate was not available for assisting agricultural education, nor was financial assistance then given by the Board of Agriculture. The only funds for such instruction were grants allocated for technical instruction from certain Customs and Excise receipts.

The Technical Instruction Act Committee commenced work by appointing a part-time horticulturist to give a number of lectures. In the following year the present Horticultural Superintendent of the county was appointed as a part-time instructor, whilst provision was made for instruction in butter-making and poultry-keeping.

In 1893 the Technical Instruction Act Committee recommended the County Council to purchase a building at Uckfield and to acquire a training farm which subsequently developed into the Uckfield Agricultural College.

In addition to the establishment of Uckfield College, courses of lectures in veterinary science were organised in 1896, together with a scheme of field experiments and demonstrations. This scheme of field demonstrations appears to have been arranged in conjunction with the Farmers' Clubs of the county and dealt with such matters as the spraying of charlock and the application of slag.

In 1903 the Board of Agriculture made its first annual grant of £200 to the Uckfield Agricultural College, but in 1916, owing to the war, the Council decided to close the College, and it has not been reopened. In May, 1917, the administration of agricultural education was transferred from a Sub-Committee of the Education Committee to the Agricultural Education Committee, which was an Executive Committee of the County Council, and subsequently of the Agricultural Committee. At the termination

of the war this Committee, with the assistance of increased grants received from the Ministry of Agriculture and Fisheries, were enabled to extend their activities until at the present time the work of the Committee covers practically every branch of agriculture and its allied subjects. That the educational work reaches a very high proportion of those concerned in agricultural pursuits in the county is evident when it is recalled that during the years 1921-22, 1922-23, and 1923-24 there were over 21,000 attendances at lectures given on agriculture, horticulture, poultry-keeping, etc.

Instruction in Agriculture.—Instruction in agriculture has consisted chiefly of lectures to those actually engaged in farming rather than a number of organised courses for those who subsequently may become farmers. Growth of interest has been most marked during the past few years, and this is attributed largely to the efforts which have been made to give lectures based on local conditions; thus, in order to illustrate the effects of fertilisers, the lecture has been specifically confined to experiments and demonstrations carried out in the neighbourhood where the lecture is being given. In this way the sciences underlying the application of fertilisers to soils have been illustrated with concrete instances, and for audiences consisting of farmers, workmen, etc., this is psychologically the best way of dealing with such subjects.

During the past few years approximately 500 photographs have been taken of demonstrations, experiments, etc., so that there are available complete sets of lantern slides to illustrate practically all the subjects dealt with. This procedure has been adopted in order to conform with the psychology underlying agricultural education. The average farmer is only casually interested in experiments carried out at a distance from his farm, but he is intensely interested in the success, or even the failure, of an experiment or demonstration carried out on his own or an adjoining farm. Again, by the very nature of his calling, he is an acute observer, and his processes of thinking are influenced more by observation than by abstract reasoning. It is common knowledge that those engaged in agricultural work have developed the sense of observation to a very high degree, and it is because of this that the illustrated lantern lecture appeals to the farmer far more than do facts stated only verbally. The popularity of this system became so apparent that it was decided to extend it to other branches of agricultural work, and to base all lectures given on concrete instances and illustrations.

This became possible when in 1919 the Agricultural Education Committee acquired the lease of Wales Farm, Plumpton, and subsequently lectures on "The Rearing of Young Stock," "The Management of Dairy Cows," "The Feeding and Breeding of Pigs," etc., have been illustrated by photographs of the stock reared on the farm.

Although primarily the lectures given on agricultural subjects have been for farmers and farmers' sons, special efforts have been made to secure the attendance of farm workers. In the majority of districts where lectures are given farmers have greatly assisted in this direction.

Apart from lectures of this type, a number of organised courses have been given in the chief centres of the county, but the demand for lectures as apart from courses is so considerable that it is not possible with the present staff to carry on both simultaneously.

Experimental and Demonstration Work.—During the past seven years this has formed an important branch of the Committee's work. Experiments and demonstrations are arranged annually at about 30 centres. As has already been indicated, the material acquired from these experiments and demonstrations serves to illustrate the agricultural lectures. Amongst the more interesting conclusions emerging from the experiments are the following.

A considerable area of the county is covered by the Hastings Beds. These, generally, consist of soils heavy to work and somewhat similar in this respect to the average clay soil, and of such a nature that an observer unaccustomed to the soils of the county would consider that they would readily respond to the application of phosphatic fertilisers. Slag had been tried by a number of progressive farmers, but with most disappointing results, until as an outcome of the experimental work it was ascertained that on these soils phosphatic fertilisers rarely acted unless used in conjunction with potassic dressings. A number of instances are on record of farmers who had persistently used phosphatic dressings with negative or negligible results, but who, when aware of the experimental results obtained in the county, immediately remedied this condition by the addition of potash in some form or other. Figs. 1 and 2 illustrate the importance of this branch of the Committee's work.

Again, over a considerable area of the county it had been observed that it was extremely difficult to establish a plant of "seeds" (clovers). From the experimental work carried out

FIG. 1.—Untreated Plot at Wivelsden Farm, Chailey, showing the need for Potassic dressings.

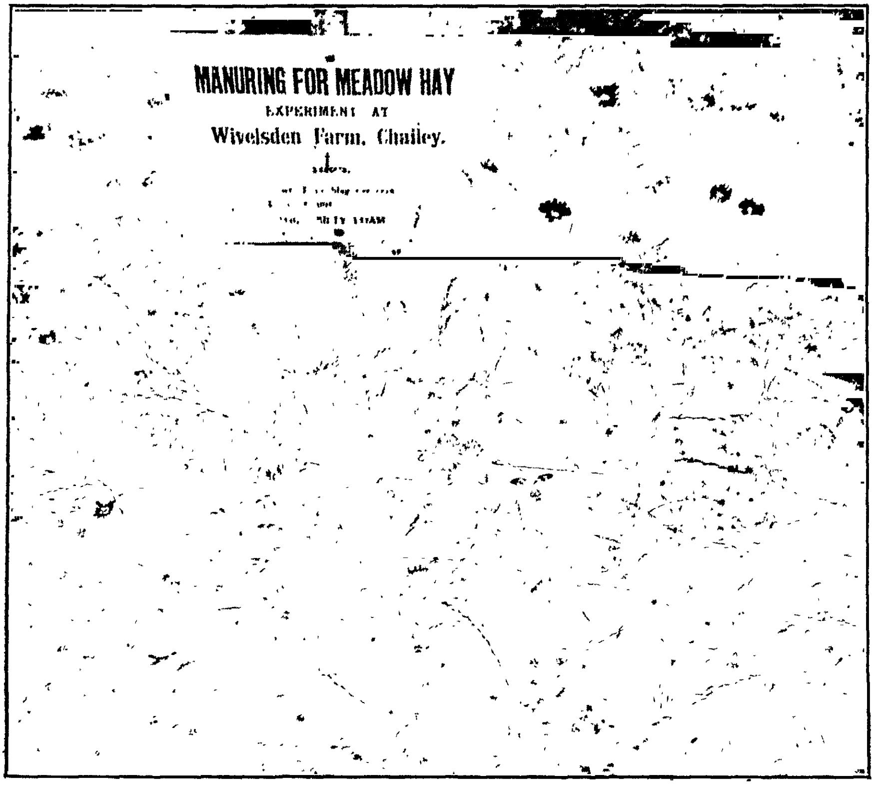

FIG. 2.—Plot at Wivelsden Farm, Chailey, treated with Slag and Kainit

FIG. 3.—Untreated Plot at Brightling, consisting chiefly of Gorse and coarse Grasses.

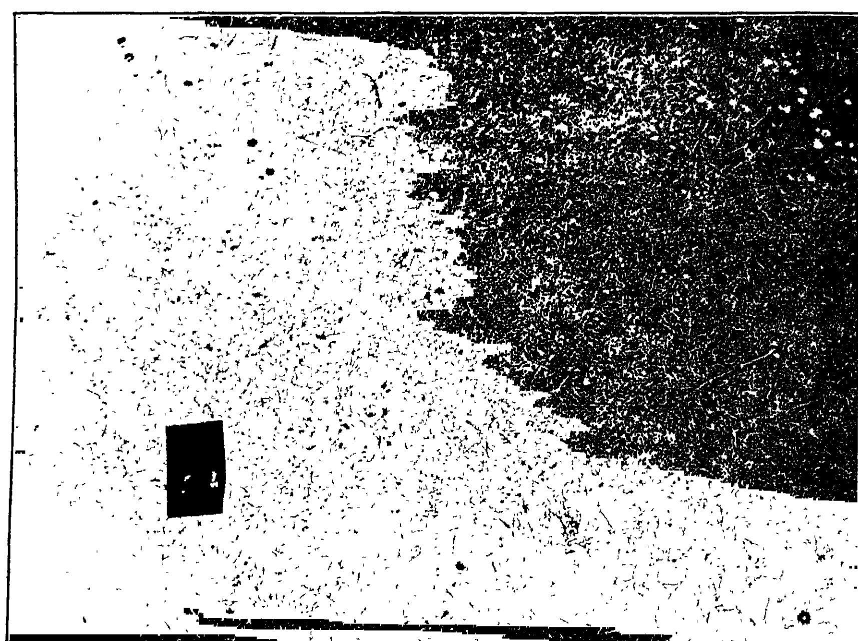

FIG. 4.—Part of Slagged Plot at Brightling, showing that coarse herbage has disappeared and been replaced by Wild White Clover which has been grazed to the ground by stock.

it was ascertained that these failures coincided very closely with acidity of the soils in question and that they were more apparent where fertilisers of an acid nature had been used. As an outcome of the experiments carried out a number of farmers in these districts were induced to use either lime or fertilisers which would counteract this soil acidity, with the result that in such cases it not only became possible to establish clover "seeds," but to obtain record crops.

A further interesting conclusion drawn from the results of the field experimental work was, that although the greater proportion of the grassland in East Sussex is distinctly deficient in lime, it is not, apparently, an economic proposition to apply lime to such fields, but an application of slag alone is usually sufficient to remedy such conditions, or slag and kainit on the Hastings Beds. Figs. 3 and 4 illustrate this point. They are taken of some demonstration plots at Brightling. No application has been made to the plots since 1921. The portion of the Park selected was amongst the roughest that could be found. It has for some considerable time been grazed by Sussex cattle, and as will be noted from the illustrations, that portion treated with slag has been fed to the ground, whilst the untreated portion and the portion dressed with lime still consist of dwarf gorse together with rough and unpalatable grasses left untouched by the cattle grazing there.

Work Carried Out in Conjunction with the East Sussex Milk Recording Society.—In 1919 a scheme for rationing dairy cattle was inaugurated in conjunction with the East Sussex Milk Recording Society, and has now grown so as to form one of the most important branches of the Committee's educational work, and incidentally has been a factor of no small importance in assisting the growth of the Milk Recording Society. It will be noticed on reference to the Year Book of the Council of Milk Recording Societies that East Sussex has a larger number of recorded herds than any other county with the exception of Essex.

The majority of the members of this Society have for the past three or four years rationed their herds in accordance with the suggestions issued by the Committee. During this period 1,731 records have been received and reported on.

Instruction in Dairy Work.—Milk production forms the most important branch of farming in East Sussex, but the county could scarcely be termed a dairying county. Production of milk had grown with the expansion of the south coast towns and

dairying, therefore, was not a long established industry as it has been in the western counties. It might have appeared, therefore, that in a milk-selling county but little scope would exist for development in dairying work. It became apparent to the Agricultural Education Committee, however, that a situation was arising when the supply of milk would at certain periods of the year, chiefly in May and June, considerably exceed the demand, especially as the large south coast towns at this time of the year do not require the amount of milk necessary later in the season. In order to cope with this difficulty the Committee in 1918 commenced a scheme of peripatetic instruction in cheese-making, starting with one small vat of 40 gallons loaned to them by the Ministry of Agriculture and Fisheries.

From this small commencement co-operative cheese-making centres rapidly sprang up; the first was started at the County Farm, Plumpton, to be soon followed by one at Hurstpierpoint, the members of which have now formed themselves into a Co-operative Society dealing not only with surplus milk, but also with the purchase of feeding stuffs, etc. A further centre was started at Steyning, and subsequently one at Lewes, whilst arrangements have also been made for similar enterprises at Robertsbridge, East Grinstead and Haywards Heath. So readily did East Sussex farmers realise the benefits accruing to them from such co-operative cheese-making centres, that during 1924 a scheme, supported by the majority of milk producers of the county, and financed by them with a subscription of 2s. 6d. per gallon on the daily average amount of milk produced, was originated, so that at the present time sufficient equipped centres exist to deal with the bulk of the milk produced in the county. It is perhaps unique that in a county where the making of a Cheddar cheese was practically unknown at the commencement of the Committee's activities, farmers should have so rapidly availed themselves of the facilities afforded by the Ministry and the Committee.*

Instruction in Horticulture.—Courses of peripatetic lectures have been regularly given in the county since 1891.

An interesting feature of the Committee's work in horticulture has been the establishment of fruit stations (Fig. 5). The earliest one to be formed was commenced in 1893 in the Uckfield district, and subsequently others were established at Rye, Northiam, East Grinstead, Heathfield, Frant and Lewes. These

* For a fuller account of this work, see this *Journal*, Dec., 1923, p. 813, "Co-operative Cheese-making Centres in Sussex."

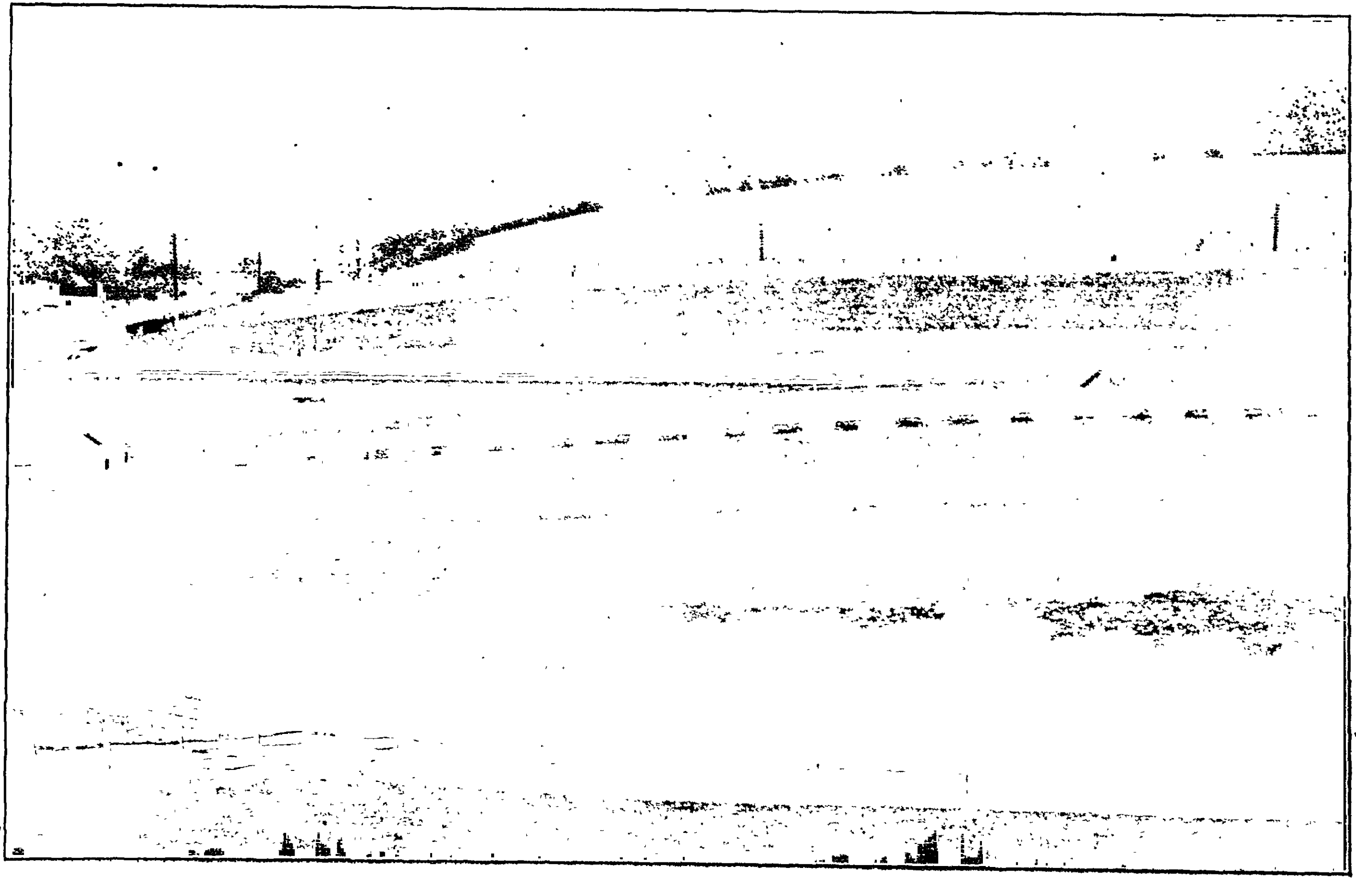

FIG. 5.—Lewes Fruit Station.

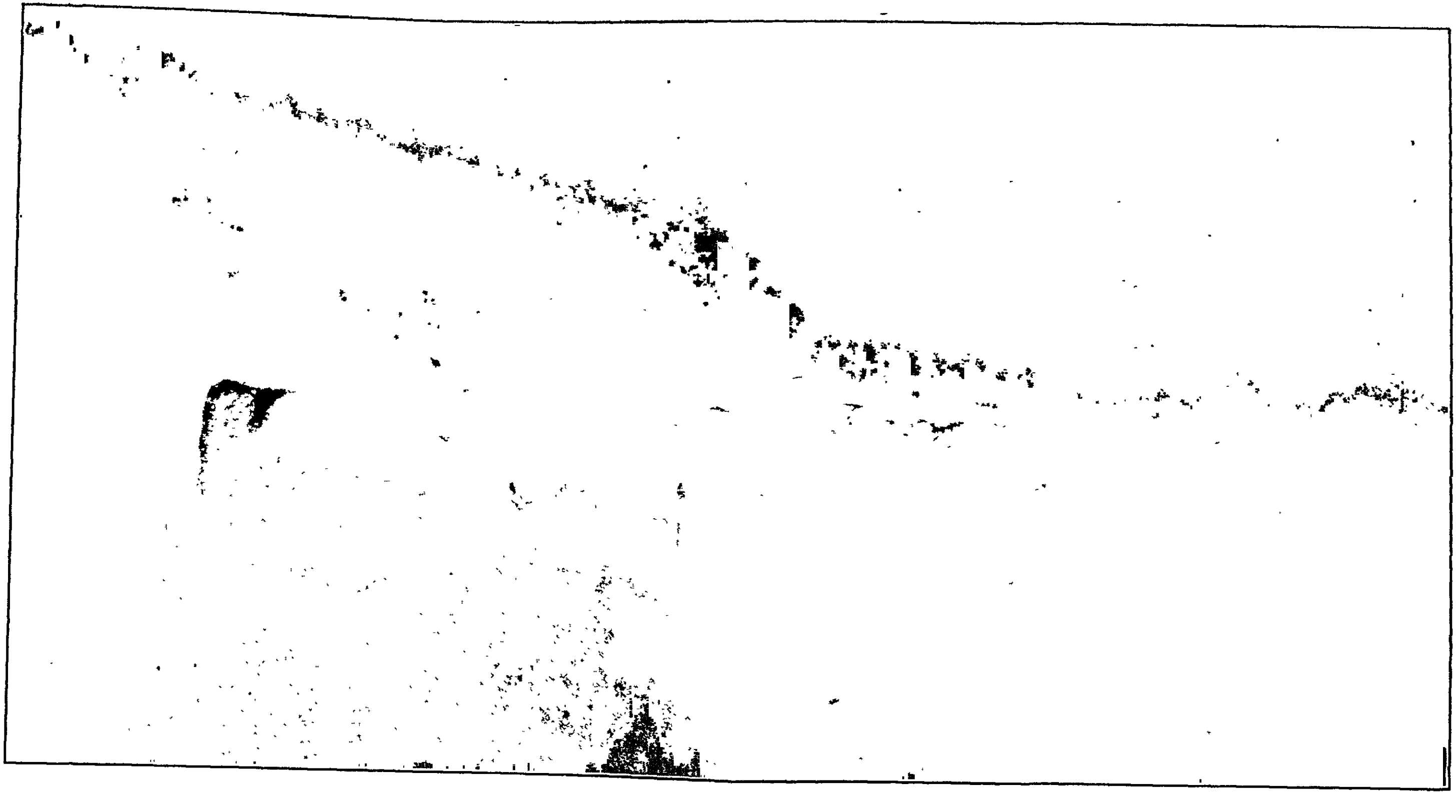

FIG. 6.—Group of Yearling Heifers reared at Wales Farm, Plumpton.

fruit stations have enabled fruit growers in the various districts to inspect different varieties of trees and have provided guidance for them in their selection as to the most suitable varieties for their particular district. Further, they have enabled growers to note the results obtained by good methods of pruning, spraying, etc. Fruit stations have undoubtedly encouraged the extension of fruit culture in the county, more perhaps in the Frant district, where an experimental field was planted; the results obtained were described in an article appearing in this *Journal*, October, 1921, p. 645. The horticultural work of the Committee is closely associated with the activities of the East Sussex Fruit Growers' Association, which was started in 1918.

Instruction in Poultry-Keeping.—Instruction in poultry-keeping has extended over practically as long a period as has instruction in horticulture, and, as might have been anticipated in a county which has specialised in table poultry to such an extent as has been done in the Heathfield district, the demand for it has been consistently great. The present instructor commenced his work in the county in 1902, and has, since that period, lectured to considerable audiences.

The establishment of egg stations was commenced early in East Sussex, the first having been started in 1905 when sittings of eggs were distributed at 2s. per sitting, most of the sittings being of the Light Sussex breed. The establishment of the centres appears to have been instrumental in developing the reputation of the Light Sussex breed, which at that date was scarcely known outside the county, but has now spread all over the country.

In 1903 the instructor in poultry-keeping assisted in the formation of the Sussex Poultry Club which has done good work in demonstrating to the public the excellent qualities of different breeds of Sussex poultry for table and general utility purposes.

At the present time there are in the county six egg and day-old chick stations under the Ministry's Scheme, whilst in 1922 two cockerel breeding stations were formed on similar lines to the egg stations.

During the past few seasons a considerable number of demonstrations in killing, plucking and trussing fowls have been given by the poultry instructor in conjunction with a late trainee from one of the training centres for disabled ex-Service men in the county. The popularity of these induced the British Dairy Farmers' Association to request the services of the poultry instructor and his assistant to give similar demonstrations at the

Dairy Show held in London in 1923, and to ask for continuance of them in 1924.

Instruction in Farriery.—In December, 1918, the Committee appointed an instructor to give courses of lectures and demonstrations on farriery. The courses have been held at a number of centres and have been well attended by the farriers in the district. In conjunction with the lectures and demonstrations, the farriery instructor visits the forges of the smiths attending the courses, and advises them concerning the best methods of shoeing, more especially in connection with pathological cases.

There is no doubt that this work, although it has only been carried on for a comparatively short time, has tended to increase the efficiency and standard of work of farriers within the county. When the delicate structure of the foot of a horse is visualised, the importance of this work can to some extent be realised.

At the commencement of the Committee's work, as far as could then be ascertained, only 8 farriers had qualified for the Registered Shoeing Smith Diploma (R.S.S.) of the Worshipful Company of Farriers. It is most gratifying to note that 116 students attending courses have been awarded, as the result of a practical and theoretical examination, the R.S.S. Diploma. Further, 15 of the students have taken the advanced courses and examinations of the Worshipful Company of Farriers and qualified for their Associate Farriers' Certificate (A.F.C.L.).

In conjunction with the instruction given by the Committee, competitions in shoeing are regularly held at the Sussex County Show. These competitions have done much to stimulate interest and to increase efficiency in farriery.

Instruction in Bee-Keeping.—In February, 1920, the Committee appointed a part-time instructor in bee-keeping, and since then a number of lantern and other lectures, together with practical demonstrations in the handling and management of bees, have been given to most of the horticultural societies, women's institutes and other organisations in the county. The Committee established an apiary in 1920, primarily for the formation of nuclei for restocking purposes. The establishment of the apiary did much to remedy the serious depletion of stocks of bees which had arisen owing to disease. The demand for nuclei from residents in the county far exceeded the supply. When possible lectures and demonstrations are given at the apiary, which is always open for visitors to inspect.

In addition to lectures and demonstrations, the instructor in bee-keeping has visited and given individual instruction to several

hundred bee-keepers, and he deals also with a considerable amount of correspondence on the subject. The appointment of an instructor in bee-keeping has not only tended to increase the number of stocks of bees kept, but has further assisted in disseminating knowledge concerning acarine and other diseases of bees.

Instruction in Veterinary Science.—In 1920 the Committee extended their work by arranging a series of lectures dealing with veterinary matters. These lectures have been continued since that date and appear to be greatly appreciated by the farming community. The Committee consider that they serve a most useful purpose by disseminating knowledge of infectious diseases, etc., which may often be prevented and their ravages controlled if the farmer has a deeper knowledge of the causes of these diseases. It is not the wish of the Committee for such lectures to replace the services of the veterinary surgeon, but rather to give the stockmen a deeper insight into the causes of diseases which often occasion such considerable loss on farms.

Instruction in the Production of Clean Milk.—A considerable number of lectures have been given in the county dealing with the production of clean milk. Further, in conjunction with the Sussex Agricultural Society, clean milk competitions have been organised and carried on since 1921. Similar competitions now find a place amongst the schemes of a number of ploughing associations. In conjunction with these associations the County Council award certificates of efficiency to the winning stockmen.

Instruction in Manual Processes, Thatching, Hedging, Etc.—It has been the policy of the Committee to encourage instruction in manual processes by co-operation with the ploughing associations existing in the county, and as with clean milk competitions, award certificates of efficiency to the winning competitors. In addition, the Committee in 1919 organised a series of competitions to encourage thatching by novices. By this means they succeeded in training 75 young men who had not previously thatched a stack. This work is being extended with the assent of the Ministry by the appointment of a peripatetic instructor in thatching.

County Farm.—Reference has been made to the part played by the County Farm in connection with instruction in agriculture. Amongst the aims of the Committee when commencing work on this farm were the following:—

To demonstrate the beneficial effects in rearing good class dairy stock of systematic selection of the dairy herd and the use of pedigree bulls.

Fig. 6 illustrates examples of young stock which have been reared on the farm, whilst the success of the Committee's endeavour in this direction can be judged by the fact that the Executive Committee of the National Farmers' Union, after inspection of the stock bred on the farm, requested the Committee to arrange a scheme so that bull calves could be distributed amongst the dairy farmers in the county. This request was willingly acceded to by the Committee, and the demand for such calves has considerably exceeded the supply available.

A number of demonstrations on the improvement of grassland, varieties of cereals, etc., are also carried out on the farm.

An account of the results obtained from a herd of pedigree Large Black pigs was dealt with in this *Journal* for May, 1924, p. 150 : (" Some points concerning Pig-Keeping ").

With the consent of the Ministry the Committee are establishing at Plumpton a Farm Institute, in order that systematic courses of instruction may be given to complete their scheme of work.

A scheme of agricultural education in any county cannot be successful unless it receives the willing support of those engaged in the industry, and in this direction the Committee have been most fortunate in securing the co-operation of the various branches of the National Farmers' Union, Women's Institutes, Farmers' Clubs, Ploughing Associations, and the local press, all of which have most willingly assisted the Committee's activities.

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MILK SUGAR FROM WHEY: EXPERIMENTS AT THE MINISTRY'S LACTOSE FACTORY.

WITH the development of the manufacture of cheese at depots and factories the disposal of whey has in many cases become a very pressing problem. The quantity produced in a factory, its bulk and the high cost of transport, make it impracticable to return the whey to farmers for feeding to live stock; and if it is run into water courses and sewers or over the land a nuisance is created that may sooner or later lead to the intervention of the local sanitary authority. In these circumstances, as whey contains about 50 per cent. of the solids in the original milk, there appeared to be good grounds for instituting an investigation into the possibility of utilising the whey in some manner that would yield a profit. With this end in view the Ministry decided to equip an experimental factory, and in order to ensure a certain

supply of fresh whey, it was erected at Haslington, near Crewe, on land adjoining a cheese-making factory owned by the Barthomley Farmers' Dairies, Ltd.

The investigations at Haslington were mainly concerned with the production of milk sugar, but, before the opening of the factory in 1921, experiments in the extraction of whey solids were carried out at Nottingham in 1919 and at Haslington in 1920. The apparatus was similar to that used in the production of dried milk. The yield of solids was about 640 lb. per 1,000 gal. of whey, and the cost of production at prices ruling to-day was $2\frac{1}{4}$d. to $2\frac{1}{2}$d. per lb. Laboratory tests in the extraction of milk sugar from the solids gave satisfactory results, and, in the opinion of the Director of the Rowett Research Institute, there were grounds for believing that the solids would form a satisfactory basis for a cheap and nutritious food for children. The material obtained from the earlier experiments was sold for use in the preparation of foods and realised 7d. per lb., but the market for this purpose was not maintained, with the result that the produce of later experiments (1921 to 1923) was sold for cattle feeding at prices ranging from 4.08d. to 2.17d. per lb.

Two experiments in the production of condensed whey were carried out at Haslington, and it was ascertained that, when condensed to one-sixteenth of the original volume, the whey kept well, although a slight cheesy flavour developed. It is doubted, however, whether this method of dealing with whey is practicable in the smaller cheese factories owing to the cost of the vacuum plant and the technical knowledge required, but, generally, the experiments indicated that it is worthy of further consideration.

Production of Milk Sugar and By-Products.—*Butter.*—The first step in the process in operation at Haslington was the extraction of cream for butter-making. This was effected by heating the whey to 120° F. and passing it through cream separators. During the first year's work it was found that the butter made from this cream developed a cheesy flavour, but this fault was remedied in the following years by raising the temperature of the cream to 170° F. immediately after extraction, and then cooling it quickly. After inoculation with "starter" the cream was allowed to ripen, with the result that the butter produced was almost indistinguishable from that made in the ordinary way. The yield of butter was about 20 lb. per 1,000 gal. of whey.

Lactalbumen.—After extraction of the cream, the acidity of the whey was adjusted, and the lactalbumen was coagulated by

heating the whey to 200° F. in vats fitted with open and closed steam heaters, and with stirrers. The lactalbumen was extracted by the use of two filter presses served by a two-throw pump, the liquor being twice filter-pressed. The filtrate was again fully neutralised between the two pressings. The lactalbumen was then dried and stored, and the liquor passed forward to a clear liquor vat.

The method of adjusting the acidity of the whey was to add stale whey if the acidity was too low, or to add milk of lime if the acidity was too high. It was found that lactalbumen could best be coagulated when the acidity of the whey was such that 10 c.c. required from 3.5 c.c. to 5 c.c. of decinormal caustic solution to neutralise it, using phenol-phthalein as an indicator. It was also proved that it was more satisfactory to heat the whey during the process of coagulation by means of open steam, a temperature of 200° F. being reached in about half the time necessary when using steam coils. The average yield of lactalbumen was 58½ lb. of dried cake per 1,000 gal. of whey.

Calcium Lactate.—In the case of some of the more acid supplies of whey received it was found that neutralisation by the use of milk of lime caused the formation of calcium lactate in considerable quantities. The removal of this impurity in the refining process is referred to later.

As calcium lactate in itself has a certain commercial value, laboratory tests in the production of this article by direct fermentation of the whey were carried out. The results were satisfactory, and it is thought that if the cost of production could be cut, so as to compete with the German product, this process would provide a possible solution to the question of whey disposal.

Milk Sugar.—The liquor remaining after the extraction of the lactalbumen was passed from the vat to the Kestner evaporator, where the bulk of the water content was removed. The resulting syrup was then boiled to grain in an aluminium vacuum pan. The *massecuite* was then discharged into the crystallising vats, where it was allowed to crystalise before being fed to the hydro, where the grain was separated from the molasses. The grain was discharged into trays with perforated zinc bottoms placed in the drying cupboard, the remaining molasses draining through into a slate tank. This molasses was concentrated *in vacuo*, allowed to crystallise, and then treated in the same manner as the original *massecuite* to extract any remaining grain.

Refining the Sugar.—In re-crystallising the crude sugar in the process of refining and in dealing with the molasses, several methods of getting rid of the calcium lactate were tried. In

1921 calcium lactate was converted into sodium lactate, and on a second re-crystallisation a sugar containing only .05 per cent. of ash was obtained, but as the sodium lactate prevented a good quantity of the molasses from crystallising out, this method was not regarded as satisfactory. In 1922 a similar but more elaborate method, was employed, but difficulty was again experienced when dealing with the molasses. The most successful method was that employed in 1923, namely, to precipitate the lime of the calcium lactate by the use of disodium phosphate. The results of the work in 1922 and 1923 are set out below.

1922.—30,000 gal. of whey were dealt with, and 9,270 lb. of crude sugar were obtained, together with 4,533 lb. of molasses. This molasses was estimated to yield a further 989 lb. of crude sugar, making a total of 10,259 lb. In refining, a loss of 14 per cent. was incurred. The sugar was of excellent quality and sold for £90 per ton.

1923.—A quantity of 77,359 gal. of whey was dealt with, and 22,657 lb. of crude sugar together with 956 gal. of molasses were obtained. On re-crystallising, 17,604 lb. of sugar and 270 gal. of molasses were obtained. At the date of the report, the molasses had not been treated to extract the remaining grain. Part of the sugar, however, had developed a bad colour in re-crystallisation and had to be re-worked. After this process, 16,249 lb. of sugar were obtained, which, on grinding, yielded 15,922 lb. (including 58 lb. of mill sweepings). This sugar was sold at £76 to £87 10s. per ton. The smaller yield of sugar in 1923 was due mainly to the loss of small crystals when centrifuging. It is considered that a system of crystallising in motion would be much more satisfactory than allowing the syrup to stand and crystallise.

Sale of By-Products.—The sale of butter may be disregarded as the quantity is so small. It is considered that if the cost of production of lactalbumen could be lessened by a modification of the process it would find a good market as a basis of human or cattle food. No market has yet been found for molasses, but in view of the high carbohydrate content, it should prove of value commercially. The production of calcium lactate from molasses is worthy of consideration.

Commercial Production of Milk Sugar.—In considering the production of milk sugar as a means of disposal of surplus whey, it must be remembered that the supply of whey is usually seasonal, and is dependent also upon the demand for fresh milk. It is essential that if factories similar to that at Haslington

are to work with any prospect of success they must be situated in areas where there are a number of cheese-making factories within reasonable distance, so that there would be a regular and sufficient supply of whey. In view of the high cost of transport and of the rapidity with which the whey becomes acid, it would seem that the conveyance of whole whey beyond a distance of 5 or 6 miles is not a commercial proposition. The quantity of whey dealt with at the Ministry's factory was not sufficient to enable an economic test to be made, but, from the data obtained, it is thought that the minimum daily supply necessary for the economic working of such a factory might be between 3,000 and 5,000 gallons over a period of not less than 150 working days.

At the close of 1924 the experiments at Haslington had reached a stage where the precise nature of the future inquiries necessary to complete the investigation had become defined. These further inquiries are being conducted by University College, Reading, and the lactose factory at Haslington has been lent to that University for the purpose.

A more detailed Report (typewritten can be obtained from the Ministry, 10, Whitehall Place, S.W.1., price 6d., post free.

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PACKING APPLES IN THE OKANAGAN VALLEY, BRITISH COLUMBIA.

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THE bulk of the fruit crop of British Columbia is grown in the Okanagan Valley, a district picturesque in every way, but not one where English fruit growers would expect to see fruit grown. The valley is over a thousand feet above sea level and has a large and deep lake of deep blue cold water running down the centre for 80 to 90 miles. Towering immediately above the lake in the east are the rugged mountains of the Gold Range, and on the west those of the Coast Range. The mountain slopes, and the fields, other than fruit plantations, look like heaps of dry dust, except for " bunch grass " which is the only plant of economic value that appears to be able to exist and produce cattle food in these dry belts, where the sun shines brightly all day long and for nearly every day of the year. In winter the area is snow-bound and the temperature very low. In past ages the mountains have been much subjected to glacial action, when the soil was brought down the steep mountain sides and deposited as benches on the slopes immediately above

fruit trees are planted. It was discovered that if the snow-water from the mountains could be led on to the soil of the benches, the response was wonderful—large crops of almost any vegetables or fruit of the finest quality could be produced in great abundance. This has led to the development of a big fruit industry on those tracts of land that could be watered regularly and at any period throughout the summer. Those not so favourably situated remain almost a barren waste.

Every bit of the irrigated soils has been planted with fruit, so that the area has become compact, of great similarity and devoted to the production of the same kind of fruit. This made it easier for the establishment of societies for the development of marketing schemes on co-operative lines, besides which the systems of irrigation could only be undertaken collectively, and so from the beginning a co-operative spirit was fostered. In this rugged, mountainous area the benches of flat land are by no means continuous, for at times the steep slopes roll down to the lake, quite cutting off one fruit bench from its neighbour, and each has an isolated fruit area of its own.

At the top end of the valley, by the Canadian Pacific Railway main line, the country is less mountainous, and the level land runs away in many minor valleys, and large tracts are planted to fruit. Here at Salmon Arms one finds 1,120 acres of fruit and at Vernon 4,828 acres. Then come high mountains, but half-way down the lake on the east side the mountains stand away back leaving many benches of land at Kelowna and Westbank, where 4,911 acres of fruit are said to be grown. All these fruit benches are overshadowed by the many tall and rugged mountains in the background and away to the south. On the opposite side of the lake fruit benches occur on the high slopes at Peachland, 561 acres; Summerland, 2,435 acres; Penticton, 2,144 acres; and Keremeos, 688 acres. All the orchards are planted primarily to apple trees, with a few trees of pears, plums, cherries and prunes.

From Penticton the blue water of the lake is seen stretching away northwards further than the eye can reach. Along each side are the benches of fruit trees, of apples, pears, cherries and peaches, robed in autumn foliage of many colours, so that a glorious mixture of bronze, yellow, red and pink meets the eye. Higher up on the mountain side, there is the dry, grey bunch grass, and then the brown spruce trees, which stretch away up the mountain almost to the top, the line getting ever thinner as the snow-line is approached. Overhead the sun

shines brightly; no sign of a cloud can be seen, and the fruit trees would stand but a small chance if the melted snow-water had not been harnessed in its downward course and led to replenish the moisture in the soil. From other places the scene is equally good, for the whole area seems to have been made for the delight of the tourist rather than for exploitation by the fruit grower.

Improvements.—The fruit growers of British Columbia are confining their attention to improved methods of production, making a special effort by good cultivation, careful thinning of the fruits, and numerous sprayings to produce apples suitable for packing into boxes, and that will grade mostly into the highest class, for culls and low-grade fruits are of little use to them. Where the growers continue to pack their fruit at home they have built small packing stations on the ranches, where the apples are graded and sized by hand on the bench system, though a few, with large plantations, have fitted small grading machines as permanent equipments. Even when packed on the ranch the boxes, as a rule, are handed over to the local societies for storage and marketing. With most growers it has become the practice to hand over the "orchard picked" fruits to the packing houses to be graded, packed and marketed. It is not that the growers are unable to grade and pack, but the surrendering of the work is due to the recognition of the fact that a real standardisation of pack for the whole valley can only be secured effectively by the general adoption of central packing. The method of organisation and process of working of the packing stations can best be illustrated by describing those of a few of the most important associations in the Okanagan Valley such as the Penticton Co-operative Growers' Association, the Kelowna Exchange and the Vernon Fruit Union.

The Penticton Co-operative Growers' Association was incorporated in 1913 under the Agricultural Act of British Columbia as a fruit company with a nominal capital of unlimited amount divided into shares of five shillings each, of which only £710 has been issued. The other capital necessary to finance the business has been obtained in the form of loans from the Provincial Government of British Columbia and from the banks. These loans, which are secured as a first mortgage on the plant, are being paid off by deducting certain agreed percentages of money from the market returns of the growers. The Association has two large packing stations well-equipped with machinery, and spacious warehouses for storing fruit.

FIG. 1.—One of the Penticton Co-operative Growers' Packing Houses.

FIG. 2.—A "Ranch" Packing House operated by four Growers at Penticton.

FIG. 3.—The largest Packing House at Summerland, situated between the Road and the Lake to facilitate the Delivery and Despatch of Fruit.

FIG. 4.—A Packing House of the Vernon Fruit Union.

At the head of the Association there is a President and a Board of Directors, all of whom are elected at the annual general meeting. There is a general manager, a secretary and a treasurer, who are responsible for carrying on the business of the Association which, in some seasons, is large and extensive. In 1923, for instance, the expenditure incurred in handling and packing the crops amounted to £25,410 in packing expenses, and £6,650 in general expenses, which expenses were met by deducting from the growers' returns for apples 2s. 2d. per box, and appropriate charges per package of other fruits.

The Society has two hundred and forty members, and in a good fruit year handles two hundred and fifty to three hundred thousand packages of fruit. Each delivery of fruit has to be separately recorded in the books, for each grower must be given a true statement of the grading of every box of his fruit, and paid strictly according to the merits of his deliveries.

The grower delivers his orchard boxes of fruit to one end of the packing station, where they are taken to the top floor of the building by means of an elevator specially constructed to handle open boxes. The elevator delivers the boxes on to a gravity elevator inside the building whence they are run to some convenient point for storage to await the grading process. The fruit of each grower is stored separately, six boxes high, and the last box bears a ticket showing the name of the owner, the variety of apples and the number of boxes delivered. A copy of this ticket is handed to the grower as a preliminary receipt for his fruit. Farther down the room are two large machines of the Cutler type, and a staff of forty people ready to grade, size and pack the fruit of each grower according to a common plan.

When ready to start the truck-man wheels his truck to the pile of orchard boxes, depresses the lever so that the jaws of the truck grip the bottom box and make it possible for the pile of six boxes to be moved bodily without further handling up to the grader platform; here another man—the hustler—feeds the apples into the grader, box by box, and it is his job to keep a steady and continual stream of apples passing over the sorting table under the vigilant eyes of six skilled women graders. Generally, the apples of fancy grade, being the predominant grade, would be allowed to pass untouched along into the sizing cups, where they are sized according to weight into eight different sizes and dropped into bins in the first section of the grader. The superior apples (Extra Fancy Grade) would

be picked out and placed on the left-hand conveyor, on which they travel down to the far end of the grader, where they are sized according to weight and finally gently dropped into one or other of the eight bins on the left-hand side at the far end. Apples of the C grade, *i.e.*, somewhat inferior to fancy, go on to the right-hand conveyor, and travel down after sizing into the eight bins at the far end on the right-hand side. The cull apples, *i.e.*, the small apples, the bruised apples and apples with scabs or blemishes, or even good apples without the stem adjoining, are placed on the middle conveyor and taken in another direction to orchard boxes for return to the grower. These cull apples are not handled by the packing stations, and become almost a dead loss to the grower, so much so that many growers just leave the culls unpicked on the trees.

The sorters must be expert at their work, *i.e.*, they must thoroughly understand the standard of grade required for each variety and have eyes trained to take in the merits and defects of each apple as it is turned by the rollers of the sorting table, and hands which operate like machinery, ever ready to pick out the superior and inferior apples, and to place each on its proper conveyor for delivery to the correct bin. By the sides of the bins along each side of the grader are a number of girls, it may be eight or ten, ever busy, wrapping the apples in tissue wraps or oil paper, and then placing each in its proper place in a labelled box, steadily piling up the apples pack by pack, and layer by layer, until the box is filled. All the packers work quickly and do their work well, but a trained eye can easily detect the slow movement of the less experienced and the more rapid work of the expert, who can pack a box of the large apples in less than three minutes and complete twenty boxes within the hour. Both hands work in unison, the right taking the apple from the bin whilst the left snatches the paper wrapper from the tray; then both hands travel towards each other so that apple and paper meet directly above the box; by a slight twist of the wrist the paper is secured round the apple, which is then placed by the right hand in the box whilst the left automatically travels back towards the paper rack. So the work proceeds, fruit by fruit, layer by layer, box by box, bin by bin, throughout the day so long as the fruit holds out.

These packers all work at piece rate (2¼d. per box) and the quick and skilled workers can earn much money. Nearly all the girls could manage 70-80 boxes a day, whilst the best have been known to pack 200 boxes, but no encouragement is given by the management to pack at such a rate.

The packer stamps the box with her special number, when a man removes the full box to the gravity elevators which run on both sides of the grader down to the box press, away at the far end of the room. Here the cover of the box is put on and fastened under pressure by nails. The name of the variety, grade and number of apples in the box are stamped on the label, and the box is ready for storing with those containing similar fruits. At the back of the box press sitting at a small table is a checker, whose business is to take records of the boxes as they pass on the conveyors, so that at the end of the day his books will show the number of boxes packed by each girl and at the end of the run the detailed grading and packing of the fruit of each grower, *i.e.*, the number of boxes of Extra Fancy, Fancy, C Grade and culls, together with the number of apples packed in each box. This information is given to the grower and completes his final receipt. Growers say that these grading records are exceedingly valuable in indicating where methods of production are faulty. Too many culls from worm injury indicate that spraying was neglected or inefficient; too few Extra Fancy show that the trees are so thick as to prevent the sun from colouring the apples; where small apples predominate, that thinning was not sufficiently drastic, or that insufficient irrigation water was used. These grading results are certainly wonderful guides to an intelligent grower and must serve as a stimulus in raising the general standard of production.

Gravity elevators take the packed and fastened boxes to the floor below, where similar grades of the same variety are being assembled and stacked. This floor is on a level with the railway track, where several box vans, fitted with refrigeration plant, are drawn up, in which 750-800 boxes are being arranged for transport to Vancouver, or the Prairies, or it may be for shipment to England or Scandinavia. The boxes of fruit are checked into the packing houses by one man and the graded fruit is checked out by another, whilst a little self-registering machine—a sort of counting machine—is often used in addition. These double and treble records act as a great safeguard in keeping track of the exact number of boxes and makes the detection of pilfering an easy matter.

The operations of receiving the "orchard run" boxes of fruits, the grading, packing, nailing, checking, labelling, storing, packing into railway vans and dispatch, are continuous throughout the day, and for every day that the packing house

is open. There is a person for each particular job, and each performs only his allotted task, though all have to act together and at the same speed to keep the whole house busy. No one can slack or the whole movement becomes blocked. The man who feeds the grader is appropriately called the hustler, for he sets the pace of the whole house, though naturally the real responsibility rests with the packing foreman who is always present casting his observant eye on graders and packers to see that none of the work is scamped, or improperly performed.

In charge of all the operations is the Manager of the packing house. He is responsible for the organisation and staffing of the house, for keeping a proper system of book-keeping, for notifying growers concerning the grading of their apples, and for seeing that the grading, packing and labelling are up to the standards set by the Government Fruit Act, for Government Inspectors visit the houses daily and examine the packed boxes. In case of default the manager is the person held responsible.

At Penticton similar work was in operation in the second packing house, so that the total staff of people employed in receiving fruit, grading, packing, storing, dispatching and book-keeping by this Association certainly exceeded 100, which gives some idea of the busy scenes in these houses and some measure of the size of the industry built up by the collective efforts of the growers.

A few growers at Penticton have not joined the co-operative movement, and these strive to carry on business with the independent shippers. In one instance, a group of four growers had established a packing house of small size, fitted with an ingenious circular sizing machine, which had a daily output of five hundred boxes. The staff at work here was as follows:—A manager, one trucker, four graders, five packers, one press-man and one stacker. The girls were encouraged to pack a high-grade pack, which meant rather slower work, averaging 70-75 boxes per day, so that the packing cost would work out at 2s. 4d. to 2s. 6d. per box inclusive.

The Summerland Co-operative Growers' Association.—From Penticton it is but a short distance by boat or road to Summerland, where the Summerland Co-operative Growers' Association operates several packing houses. The largest of these is 300 ft. long by 60 ft. wide, and lies between the main road and the lake, so that delivery and dispatch of fruit is comparatively easy. In this house, storage is made on the top and basement

floors, and the grading and dispatch from the middle floor. Three Cutler graders, with twenty bins on each side, are in use, and the house has a daily output of 2,500 to 3,000 boxes, and a total seasonal output of over 150,000 boxes of apples besides other packages of fruit.

The staff employed and the operations performed are very similar to those described for Penticton, with but a few slight adjustments to suit the different shape of the building.

This Association was incorporated as recently as 1923, for the purpose of taking over the packing houses of the independent shippers, so as to centralise the work into one company operating under the control of the growers. The necessary capital to do this is being acquired by deducting 2½d. for every box of apples sold over a period of years, so that in about eight years from this date the loan will be paid off and the houses will belong to the Association.

Kelowna Growers' Exchange.—Further up the valley, at Peachland and Gelathly, there are companies with packing houses all working on similar lines, packing the same varieties and endeavouring to secure a standard sample of Okanagan apples. Across the lake at Kelowna, where perhaps the largest quantity of apples is produced, one finds the packing again done on co-operative lines by an association of growers operating as the Kelowna Growers' Exchange. This Exchange was incorporated in 1913, but its operations were considerably enlarged in 1923, when the packing houses of the independent shippers were secured at a price of £25,000, and the whole business centralised under one management. The Exchange, prior to this, owned packing houses at Kelowna, Okanagan Mission, East Kelowna and Winfield, but the number now is more than double. Most of these houses are not of great size, which makes the cost of supervision and handling somewhat more expensive than if the work was done in a few houses of a larger pattern. The capital of the Growers' Exchange has been obtained by issuing direct shares and promissory notes to growers, and by securing Government loans. These loans are now being paid off by deducting 2½d. per box of apples from the growers' market returns. In 1923 the Kelowna Exchange packed and shipped 921,622 boxes of fruit, of which 649,079 were apples, at a total cost of £90,700, which was recovered by charging for packing and shipping at the rate of 1s. 11½d. per box, with 5d. extra for overhead expenses and 3 per cent. added to build up a reserve fund, making 2s. 5d. per box in all.

The President of the Kelowna Association, Mr. Lionel Taylor, an Englishman, took the writer to see the house at East Kelowna, where a very large grading machine was in use. The machine has been formed by joining side by side four large Cutler machines. There are no bins. The apples, after sizing, drop on to moving canvas platforms and are led away on both sides to the packers. The culls are led by other conveyors into a box of 40 lb. capacity, until full, when the bottom was opened by a lever and the apples dropped out and were led off to the farmer's bin outside. The box was also connected to a counting machine so that the record of the culls was taken automatically. This grader required the following staff to operate it at full speed, 2 truck men, 3 dumpers, 21 girl graders, 26 girl packers, 3 or 4 press-men, 1 checker and 5 men packers in the store room.

This house, which is being managed by Mr. J. H. Moore, a native of Chester, contains simple devices whereby the apples and boxes are moved and the boxes even counted by simple mechanical devices, and manual labour has been reduced to a minimum.

Vernon Co-operative Fruit Union.—Between Kelowna and Salmon Arms there are a number of other associations, all important, but space will only permit of the mention of the Co-operative Association at Vernon, which trades as the Vernon Union. This Union has several packing houses, with one situated in Vernon of enormous size. It is 400 ft. long by 80 ft. wide, and consists of a splendidly built structure with basement, main floor and first floor. The house operates five Cutler grading machines capable of dealing with 5,000 boxes daily. The packing building proper occupies but 100 ft. by 150 ft., leaving a very large space for the storage of the apples, other fruits and boxes.

In 1923 this Union, which has 300 members, packed 860,000 packages of fruit, of which 657,824 were box apples.

The charge for packing is arranged at the beginning of each season by the Board of Directors, who take into consideration the charge made for the previous year, the financial position of the Union, the size of the crop, etc. For this season the charge for apples was 2s. per box inclusive, though in addition other deductions from the growers' market returns are made for the purpose of building up a reserve fund and for paying off the debt on the general packing houses.

Extent of Co-operative Packing.—Throughout the whole Okanagan Valley, from Salmon Arms in the extreme north, to Penticton in the south, and even in the adjoining Kootenay Valley these co-operative packing houses exist, not regularly but just as frequently as the needs of the industry demand, so that growers have not more than 2 or 3 miles haul for their fruit. The number of houses where packing is being done is put at 192 by the Inspectors of the Department. Some belong to private growers, but the majority are associated with one or other of the thirty unions, associations and exchanges, established co-operatively by the growers. Some of these are crude wooden structures fitted with bench graders and home-made equipment; but nearly half are well established buildings, with grading rooms properly furnished with the most modern grading and packing plant, power and gravity elevators and other labour-saving machinery, and plenty of warehouse accommodation and ordinary air-cooled storage rooms. Some of these properties belong to the associations, though most are at present carrying mortgages, but when the loans have been paid off, the whole of the establishments will become the property of the growers and will, *en bloc*, constitute one of the largest growers' holdings in the Dominion.

Associated Growers of British Columbia, Ltd.—None of the members of the local associations—nor even the packing houses—are permitted to sell fruit on the open markets, and the function of each one is clearly understood. The business of the growers is to produce fruit, and that of the local association is to grade, pack and dispatch the produce; but neither must deal with the business side of selling, for which purpose there has been established a central selling agency which trades as the Associated Growers of British Columbia, Ltd., from offices situated in Vernon. This organisation sells the fruit for all the 30 locals and for fifty or so outside growers besides. The business affairs of the selling agency are controlled by a Board of 17 or 18 Directors, elected to represent the several districts in the proper proportion of the deliveries. It has a paid President, General Manager, Sales Manager, Packing House Inspectors and other staff sufficient to conduct the business of such a huge undertaking. The selling agency has endeavoured to secure a fairly level standard of packing in all the houses and whilst permitting the identity of each house to be associated with its own boxed apples, it has secured the general adoption of a uniform label on all boxes containing fruit of Extra Fancy

and Fancy grades. This central selling agency, in 1923, disposed of 3,132,182 packages of fruit, of which 2,497,327 were apples, as well as 12,916,102 lb. of vegetables. These figures serve as a measure of the size of the business which the growers themselves have established and are now operating in this part of Canada.

The central selling agency necessarily works in the closest touch with packing houses, selling their fruits, giving orders for dispatch and arranging for payments—which is probably the most difficult to adjust of all. The fruit is sold in several markets and not all are able to pay the same price or take the same grade of fruit, and unless distribution is well organised, markets become glutted and prices depressed. The markets of Canada, chiefly those in the Prairies, are able to take 70 to 75 per cent. of the output, but no more, and sales in these markets are generally made on the f.o.b. basis at the consignor's station. The other 25 to 30 per cent. has to be exported to the U.S.A. and Great Britain, at prices which can only be determined after the fruit has been finally disposed of in the auction rooms. The prices in the home markets are fairly steady, whilst the prices for the exported consignments vary considerably according to daily supply and demand.

The Pool System.—This has necessitated the adoption of a system of payment which is known as the pool system. A pool is opened for a variety, such as MacIntosh or Jonathan, and kept open until the whole of that variety is sold, when figures would be averaged and prices drawn up to show the net average returns of MacIntosh Extra Fancy large, Extra Fancy small, Fancy large, Fancy small, and "C" grade. The central selling agency then deducts 3d. or 4d. a box to cover selling charges, advertising expenses, etc., and remits the balances to the local associations. The local associations deduct the packing-house, reserve fund, and building charges and distribute the money to the growers in accordance with their deliveries, as shown in the books or on the final receipt notes held by each grower. Generally growers find that the total deductions for packing and selling and for contributions to build up a reserve and to acquire the packing house, amount to about 2s. 10½d. per box of fruit.

Naturally, it takes some considerable time before the central selling agency can determine the exact price to be paid for the variety or varieties in any one pool, and growers might have difficulties in securing money to meet current bills for labour, taxes, etc., and so most local associations have secured arrange-

ments with local banks, whereby growers can obtain advances against their delivered fruits to the local associations, who then have to recompense the bank out of the returns in preference to the grower until each claim has been repaid. The financing in the initial stages of such a gigantic undertaking by the growers would be exceedingly difficult without the co-operation of the banks—which have, in most instances, been willing to co-operate on certain terms.

In former years these fruit growers of British Columbia had to rely almost entirely on independent shippers to buy their fruit and market it for purely private gain. In years of short crops this arrangement, no doubt, proved satisfactory, but when trade was bad indifferent prices resulted, and many of the crops remained unsold. The growers have reacted by joining together to form local associations which have equipped the valleys with packing houses in which the fruit is graded and packed on a common plan, making it possible for the market to be fed with large blocks of packages all similar in every way, all under the direction of the growers, and for which service he is charged the actual cost and no more. The prices at present charged by the packing houses do not meet with the unanimous approval of the big ranchers, who feel that packing at home is somewhat cheaper, but where there are a number of small growers situated in a compact locality there can be no question as to the advantages to them of the use of a well-equipped house for grading and packing. There is a general feeling too, that the ranch packing is not so well done, because the grower superintending the grading of his own fruit may keep nearer the minimum line set by the Fruit Act rather than attempt to put up a "Standard pack" of the level set by the communal packing houses. Though perhaps it may be difficult to avoid favouring the use of communal packing houses, the tendency certainly is to make a greater use of these.

The existence of the local packing associations has made it possible for a firmer combination to establish a central agency so that the fruit can be sold or sent away to distant markets without the use of local shipping agents. The growers may have to wait a little longer for a return, but they have the satisfaction of knowing that only actual selling costs have been deducted and that no independent shippers have intervened to make an undue profit. By this arrangement the growers of British Columbia have placed themselves in direct touch with the wholesale merchants in home markets and brokers in export markets, but only to that point has co-operative marketing been taken.

In addition, the central organisation, *i.e.*, the Association of Growers of British Columbia, has been able to push propaganda in selected markets, which, it is claimed, has materially increased the consumption of apples of the O.K. Brand and made the famous MacIntosh Red apple appreciated by a wider public.

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ENSILAGE.—III.

MAKING SILAGE IN TOWER SILOS.

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Time to Cut.—In the case of the majority of silage crops grown in this country, such as oat and tare mixtures or first crops of seeds, the time when silage is conveniently made occurs between the hay and the corn harvest, or the operation may be carried out during the hay harvest in periods of damp weather, in the early mornings and at other times when haymaking is impossible. Considerations, other than the above, which are taken into account in deciding when to make silage, are chiefly associated with the maturing of the crop. This has to be considered from various points of view.

As the crop grows and matures it is at first very succulent and digestible, contains very little fibre, and yields a small crop; if cut too young before coming into ear, not only is the weight small but the crop is liable to result in the production of sour silage. In general, for obvious reasons the crop would not be cut in this stage, but it sometimes happens in the case of very fertile land that a crop of oats and tares or of oats alone becomes badly "laid" before coming into ear, and a farmer might be tempted to ensile this at once so as to be able to re-crop the land quickly. For the reason that very sour silage is likely to result, such practice is unwise unless special precautions are taken.

As the crop comes into ear, flowers and then sets and matures its seed, the stems and foliage gradually become less succulent and less digestible, with the formation of fibre within the stem and the transference of food material to the seed, which in its turn gradually fills with starch and other digestible food substances. (This process is more complete and more sudden in the case of cereals than in tares and other legumes which con-

tinue to produce new flowers and foliage after the first have been fertilised and have set seed.) The result is a gradual and continuous increase in the total dry weight of the crop and the food value of the crop right up to the time when the crop is fully ripe, so that it is desirable to allow the crop to become moderately mature before it is ensiled. It is also desirable to allow the crop to become moderately mature before ensiling because immature crops are so watery that the silage is unable to retain all the juice, part of which is pressed out and may drain away and be lost with digestible food material in solution.

On the other hand, if the crop is allowed to become too mature there is greater danger of it becoming laid and rotten at the base, and of the leaf falling off in cutting and carting.

One other consideration is also important in deciding when to cut the crop. The silage crop is generally regarded as part of the fallow crop, whether it is followed on light land by a catch crop of sheep food or on heavy land by a bastard fallow. In either case it is important if weeds are present in the crop that these be cut and ensiled before the weed seeds become sufficiently mature to shed either during cutting or carting. If this condition is satisfied then whatever growth of weed may have occurred becomes converted into silage and into cattle food.

It will be seen that these factors operate in different directions, but as a general rule it may be stated that a crop for silage should be cut in a stage of maturity rather more advanced than for hay-making, because not only is loss of foliage during carting very much less, but since the crop for silage is carted and ensiled very shortly after cutting there is little chance of any further formation of fibre after the cutting of the crop. In the case of an oat and tare crop the ideal stage at which to cut the crop probably coincides with the time when the first tare pods are fully grown in length and contain half-formed seeds, and when the oats are well advanced in the milky stage.

In the case of second crops of seeds the time of ensiling will occur just after the corn harvest, and in some cases they can usefully be made to fill up the top of silos already filled with oat and tare silage, which will have settled down during the interval, leaving perhaps the top one-third or one-quarter vacant. The maize crop comes to be ensiled last of all. In this country the difficulty is to get the crop sufficiently mature for silage-making before serious frosts occur—a light frost on the outer leaves will do little harm, but a hard frost injures the maize

stems. This crop will therefore usually be ensiled about the first week in October.

How to Cut.—The cutting of an oat and tare crop for silage may present serious problems, especially if the crop is laid and twisted. If the crop stands well with a considerable admixture of beans and cereals it may be possible to use a binder. The handling of the crop for loading and chaffing is then greatly facilitated.

In other cases, if the crop is dry and stands moderately well the sail-reaper by clearing and bunching the crop after cutting, both clears the ground for the next round of the machine and facilitates loading. In the general case, however, when the crop is heavy and laid the grass mower is used. This machine when driven to meet the crop cuts close to the ground, but the swathe board may have to be removed to prevent the crop driving, and then no track is cleared for the next round of the driving wheel. In this case the swathe has to be cleared by hand before the next round, or horses and machine have to trample over the cut crop.

Again, when the crop is twisted as well as laid even the grass cutter fails to cut the crop properly, and a very long stubble is left. These considerations illustrate on the one hand the need for growing a mixture which does stand and on the other the desirability of the engineer inventing some attachment to the grass cutter (perhaps acting in somewhat the same sense as the reel on the binder), which will lift and carry the laid crop to the cutter bar. The pea-lifter guards, which are so useful in cutting a ripe crop on dry land, do not seem to answer the same purpose with a succulent crop on heavy land in damp weather.

One other point needs to be considered under this heading, namely, the time of cutting in relation to carting and ensiling. In a previous article* it has been shown that the quality of silage depends among other things upon the interval of time between cutting and ensiling; that the best type, "green and fruity," is likely to be obtained from a crop which is ensiled immediately after cutting; that acid silage is likely to result if the crop is allowed to become partially dry after cutting; and that sour silage will be produced from a crop cut and exposed to rain for some days, so that decomposition commences in the field before ensiling. In view of these considerations, it is desirable

* This *Journal*, Nov., 1924, p. 718.

to cut each day just so much of the crop as can be carted and ensiled the same day, leaving only a few loads uncarted at night for commencement of work next day.

Carting and Ensiling.—The handling of the green succulent crop, both in loading the carts and in feeding the silage cutter, may entail heavy labour, and careful attention should be given to planning the organisation. Loading in the field is facilitated when low-framed lorries or low carts can be used, and when the crop has been cut and tied with the binder. Again, the labour of feeding the cutter is facilitated when a sloping platform has been erected by the side of the chaff cutter so that the green crop, when pitched from the carts upon this, can be easily drawn down and packed into the box of the silage cutter.

The choice of the silage cutter is important. There are several very efficient makes which both chaff the crop and elevate it into the silo in one operation. In making the choice attention should be given not only to the initial cost and to the strength and construction of the cutter, but also, from the practical point of view, to the capacity of the machine as determined by width of throat and the devices for feeding or bringing forward the green crop to the knives, since the speed at which the work of filling the silo can be carried out is often governed by the capacity of the cutter.

Filling the Silo.—In making silage in whatever type of silo the general principles involved are the same. Ensilage is the preservation of a green succulent crop by the exclusion (or limitation of supply) of the oxygen in the air from the silage material. Access of air to a heap of succulent green material results in the first place in fermentation of the silage, with the slow burning and loss of digestible food substances and the production of heat. The temperature to which the material rises is a measure of the loss of food material by fermentation. Therefore, in making silage, one of the objects is to limit fermentation by excluding air. Again, if air has access to the silage for a continued period, as by cracks in the wall of the silo, then the normal silage fermentation is followed by the growth of moulds and the silage is spoilt. Before the silo—whether made of concrete, wood, steel or other material—is filled care must be taken to see that the walls are airtight, and in the filling air must be excluded as far as possible by efficient trampling.

In the actual filling, the crop after being chaffed is blown to the top of the silo through a metal cylinder, and then

falls into the silo through a shoot, which can be directed by the operator to all parts of the silo for distributing the chaffed green crop. The silo should be filled regularly and uniformly, and as each layer of green chaff is spread out it should be uniformly trampled. It is not infrequently argued that, in filling the silo, the silage should be kept highest at the walls and lowest at the centre, and that the silage next the walls should be trampled more tightly than the centre. A little reflection, however, will show that, when this is done and the silo is eventually topped up, the centre will settle more rapidly than the sides and the silage will tend to fall from the sides to the centre, and so allow access of air and consequent moulding of the exposed silage next to the walls. A better plan is to keep the surface of the silage level or slightly highest in the centre, and to trample the whole uniformly at the sides and centre; in this way the whole settles regularly, the silage is kept closely pressed against the walls, and air is excluded.

At the beginning of the filling of the silo it is not necessary to trample the silage very heavily because the superimposed layers of silage will rapidly effect this automatically; consequently the man directing the silage shoot, with or without one helper, will be sufficient for trampling at this stage. As the silage nears the top of the silo, however, the trampling should be much more thorough, and here two or three men can be usefully employed. The need for trampling at this stage is explained both because efficient work here will increase the effective capacity of the silo, and also because it will tend to reduce the heating which is liable to be unnecessarily high at the top.

Another factor which helps to determine the effective capacity of a tower silo is the time over which filling takes place. If the filling is very rapid then no matter how efficiently trampling is carried out, the whole contents will continue gradually to ferment and settle over a period of several weeks, and before a commencement is made to use the silage it will be found that the top one-third of the silo or more is empty. To some extent this may be obviated if the filling period is lengthened so that the silage in the lower and middle parts of the silo has time to ferment and settle before the filling of the silo is complete. Thus, if a silo is filled to the brim at the end of one week and is left over the week-end it will be found that the silage has settled and that there is space for another half or full day's filling. Where such intermittent filling of a silo is practised, however, the interval between any two fillings must not exceed

60 hours, or it will be found that a mouldy layer has formed on the top, and this will persist in the silage.

It is at the top of the silage in a tower silo where most spoiling and wastage is likely to occur, and some waste here is inevitable. Under good conditions no more than 6 in. should be spoilt, but if the management is careless as much as 3 ft. of the top silage may be wasted. Care should be taken that the last 10 or 15 loads are ensiled in very succulent condition and not half-dried, as is sometimes the case, at the end of the operation. If succulent waste material such as ditch brushings or nettles is available, it is a good policy to put a few loads of these through the filler as a final top-up. If at the end of filling the crop is over-mature and dry, water may usefully be added by turning a hose-pipe on to the green crop as it passes into the silage-cutter. This adds to the weight and pressure on the top, and enables the silage to be packed more tightly.

Various methods have been suggested from time to time for exerting pressure on the top of the silage after it is ensiled, to reduce wastage at the top. A layer of 6 in. of soil is sometimes advocated. This makes a good covering because it exerts a uniform pressure and excludes air, but it is generally more expensive to elevate than the silage which it saves is worth. Dry wheat or other chaff is sometimes used. This exerts very little pressure, but helps in some measure to exclude air and is easily elevated through the silage-cutter. It is, however, of doubtful economy. In the case of maize silage a layer of seed oats has sometimes been spread over the surface so that their roots after germination may cement the surface together and prevent access of air. This again is not economical. It would seem therefore that there is an opening for someone to invent a suitable covering with which to prevent or limit wastage on the top of a tower silo.

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SOME NOTES ON RATS AND MICE AND THEIR SUPPRESSION.

THE Ministry's Technical Adviser for Rat Destruction, Mr. E. C. Read, was invited to contribute a paper to be read before the Public Health Congress at Johannesburg in November, 1924. In the course of his paper Mr. Read remarked that rats and mice have always been amongst man's deadliest enemies, working silently in the dark to destroy his nourishment and damage his health. It is now known that the black rat was

the cause of the frequent outbreaks of plague, which culminated in this country in the Great Plague of London in 1665. It was indeed long ago felt that some connection existed between rats and plague, and as early as the reigns of Henry VIII and Elizabeth statutes ordered rat and mouse destruction under the supervision of the churchwardens. In 1902 the Local Government Board ordered rat destruction in West Suffolk on account of a small outbreak of plague in the district.

A report by Major Kuhnhardt, of the Indian Medical Service, estimates that there are at least 800 millions of rats in India, each rat consuming at least 6 lb. of grain annually and defiling much more. Major Kuhnhardt estimates that in the last 20 years the loss to India is equal to £1,242,500,000, or five times India's national debt before the War, together with the death through plague of more than half a million people yearly.

Rats ruin furniture and clothing by gnawing holes for material for nest building, and cause fire through biting holes in gas pipes and destroying the insulating covering of electric wires. They also make holes in the embankments of waterworks, irrigation reservoirs and sea walls, thus leading to enormous damage and loss of life. Undoubtedly there will have to be a universal war against rats and mice, but the difficulties of such a campaign are enormous. The rat is an ingenious creature that is not easy to catch, and it is difficult to get people interested in a crusade against it. Even in England we know how indifferent many are as to their own welfare in the matter.

The important part that rats and mice play in the dissemination of disease amongst animals is now generally recognised. Trichinosis, etc., are spread by rats and mice, which harbour more parasites than any other known creature. It was not general knowledge until after the outbreak of the world conflagration that lice were the carriers of the germs of Spotted Fever (*Typhus exanthematicus*).

Rat Destruction Orders in Great Britain.—Owing to the submarine warfare a million acres of pasture were ploughed up in England and used for growing grain and other foodstuffs. It was, however, not at first realised that this new source of nourishment was the determining point for a large increase in the rat and mouse population of the country. It is well known that the natural density of the rat and mouse population of a given area is determined by the available food supply. The realisation of this fact led to the Rat Order of 1918, and the

amended Rat Order of 1919, both issued by the Ministry of Food, and it was in connection with these Orders that the systematic destruction of rats was commenced in England in 1919. The Rats and Mice (Destruction) Act, 1919, which came into force on 1st January, 1920, is the resultant permanent legislative measure on the subject. It is the earnest desire of the Government to see that rats and mice are destroyed and to help those authorities entrusted with the enforcement of the Act.

To this end a research laboratory was established and a small staff of technical assistants engaged to visit all parts of England and advise and instruct local authorities and the public generally on the safest and most efficacious methods of destruction. In connection with the research laboratory was a small factory where baits were prepared, and arrangements were completed to supply H.M. Office of Works, controlling thousands of buildings throughout the country, the Admiralty, the War Office, the Ministry of Munitions, and other Government Departments. The research laboratory and factory have now been closed.

Some years ago the destruction of rats and mice was discussed at the Royal Sanitary Congress at Birmingham, where the room provided for the purpose could only accommodate one-third of those who wished to be present. At an Annual Meeting of the Sanitary Inspectors' Association at Margate the interest in the subject was also so acute that a subsequent special meeting of officers under the Act was held to discuss matters. When the question of rats was first brought before the meetings of the various authorities interested it was generally greeted with laughter. There are still a number of local authorities in England whose members are chiefly recruited from the farming community and who have not hitherto realised the importance of the suppression of rats and mice in their own personal interest, but it is expected that in due course we shall have all the local authorities in England acting in uniformity. The Government has reserved to itself powers to enter in and have the destruction carried out in case of default, but it is hoped that such an extreme course will not arise.

Many English local authorities have appointed whole-time rat officers, all ex-Service men, and rat and mouse destruction is being carried out on sound economic lines. The onus of destruction is, of course, not removed from occupiers of premises.

The rat officer's primary duty is to see that such destruction is effected. In some cases the local authority, which, in the case of a defaulting occupier, has power to enter and undertake the necessary destruction, keeps a small staff of trained ex-Service men for this purpose and the cost of the services rendered is borne by the occupier. Thus many such schemes are self-supporting.

Early in the campaign it was realised in England that modern methods of publicity and propaganda were essential to awaken general interest in the matter. In 1919 a small exhibition was held at the Royal Zoological Society's Gardens, of all known media for rat and mouse destruction. In connection with this exhibit hundreds of practical tests were made and it was conclusively proved that the raticides advocated by the Ministry of Agriculture and Fisheries, viz., barium carbonate and red squill, were not only the safest poisons, but also the most efficacious. The results of these tests have been published in a brochure issued by the Royal Zoological Society.

Rat Weeks.—Then " rat weeks " were inaugurated. Three rat weeks were held in the winter of 1919-1920. They were popular and successful. In one county over 30,000 dead rats were picked up, and as it is rarely more than 10 per cent. of the numbers actually killed that are found it can be reasonably assumed that over a quarter of a million rats were killed in this one county during the winter.

In order to obtain the greatest possible simultaneous action throughout England, and also to remind occupiers of their obligations, it was decided to hold a rat week annually, and the first week in November is the time for this slaughter. It is quite realised, however, that continuous war must be waged against the rapacious rats and mice and that our primary duty is to see that ships do not import fresh stocks into the country to take the places of those destroyed. To this end the Ministry of Agriculture is co-operating with the Ministry of Health as to the fumigation of ships.

A typical example of an infested area was a northern port frequented by food ships from the East. As soon as these ships were emptied the rats on board (they are black and straight from the endemic plague lands) left the ships and did not return because the outward freight consisted solely of iron and steel. In this port even the Post Office, a so-called " rat-proof " building, harboured destructive and dangerous black rats from the cellars to the attics.

Examples of Rat Clearances and Damage Done.—Detailed accounts of rats killed need not be given, but an example of a town near London may be quoted. The Town Clerk and the Chief Sanitary Inspector solemnly informed Mr. Read that the town was practically rat free. Yet 8,000 rats have actually been picked up in 10 months in the town! As to damage done, many hundreds of pounds' worth of valuable foodstuffs were destroyed weekly in a foodstore in the Midlands. Under the Rat Officer's direction rats were destroyed and the place rat-proofed.

In a colliery town every roll of cloth in a large clothier's was recently bitten because the premises were not rat-proofed when rebuilt, although the local Rat Officer pointed out the necessity of this being done.

A multiple shop concern states that 300 of their 400 shops were troubled through rats. Imagine the loss of good food when cheeses are hollowed out by rats in one night!

In a south midland town three shops were infested by rats—a corn chandler's, a grocer's and a shoe repairer's. The corn chandler said that loss through rats was at least £100 per annum. Destruction cost £1. The grocer's loss was put at £125 per annum, and destruction cost £2 2s. The shoe repairer said he did not think they did any damage. One night the uppers of three pairs of boots were eaten away. The shop owner suffered a loss of £7 10s.

On a large farm in Surrey the damage done by rats to corn alone in 1918-1919 was at least £1,000. In addition there was damage to buildings. Systematic action was taken, and an average of 250 rats were killed in each of four stacks. In 1919-1920 an average of 8 rats were killed in four stacks; no damage to buildings. One can insure property against all kinds of risks, and should consider money spent on rat and mouse destruction as both a personal and national insurance. Each rat in the country costs £1 a year to keep. Imagine the personal and national loss of wealth occasioned by lack of vision in destroying these human enemies. The Consumers' Council of the Ministry of Food, in a considered report on the rat question said that £10,000,000 would be well spent in destroying this pest in England. Be that as it may, any money properly spent on such destruction bears immediate return in food saved and possible future loss through disease.

As will be seen from the foregoing the economic importance of rat repression is at the moment the chief incentive for action in England and Europe generally. It may not be long before

proofs are forthcoming that rats and mice are also the carriers of other infections fatal to man and beast which should give a further impetus to rat and mouse eradication. We may now briefly describe, on general lines, how such a campaign should be carried out.

Methods of Destruction.—A war against rats and mice is like every other conflict. Good staff work is essential to success, and the first step in the operations must be a survey. The rat infested area must be inspected and records made of the infested places. If dwelling houses, food stores, slaughter-houses or similar premises are the habitations of rats it is essential to render them as rat-proof as possible. Where the properties are drained the drains must be in order and not permit of rats entering the premises. The proper disposal of trade waste, such as empty food packages, is essential, as these often form attractive haunts and food supplies to rats and mice. House refuse and sewerage plants require constant vigilance. One must always bear in mind that the rat population of any area is determined by the amount of shelter for breeding purposes and of food supplies for existence. Not until the preliminary sanitary work is finished should systematic attempts be made to clear an area by poisons, gas, etc.

Close co-operation with adjacent areas in any rat repressive work is imperative, and when the actual destruction is to take place work should commence from the confines of the infested area and proceed to the centre.

Of the various methods of killing rats and mice, poisoning and gassing are the most suitable for preliminary attacks, trapping and hunting being employed as supplementary methods.

Poisoning can be used with care almost anywhere, and if properly carried out is the surest way of quickly eliminating large numbers of rats. Until recently arsenic, phosphorus and strychnine were generally employed in baits, but such strong poison baits are not always desirable, especially if ignorant persons or animals can obtain access to them, or poultry, dogs, cats or pigs eat the poisoned rats. As a substitute for these poisons barium carbonate preparations in various forms have been found cheap, effective and comparatively safe, the poison itself having no repellent taste. Safer still is red squill, which is generally put on the market in the form of a liquid extract and sold under various fancy names. Even better results have been obtained in many cases with squill preparations in biscuit,

cake or powder form, and a combination of wet and dry red squill baits would probably be useful in a tropical climate.

The virus method, or artificial infection with disease, is one on which to keep an open mind, but at the moment, in Mr. Read's opinion, barium carbonate and red squill poisons give much better results.

Poisonous gases are being increasingly employed for rat destruction. Sulphur dioxide generators are used by local authorities to destroy rats on town refuse dumps, etc., in England. Under certain conditions calcium cyanide (very poisonous), calcium carbide and carbon bi-sulphide can be used for the purpose.

The success of any treatment must not be judged by the number of dead rats found, particularly when barium carbonate or red squill is used, but by the amount of bait taken, and by the gradual reduction of the nuisance.

Radical rat destruction entails great effort and costs money. Unfortunately the serious damage done by these pests is often not realised either by the authorities concerned or the community at large. An efficient continuous campaign of repression is not only an economy, but a necessity. With sustained effort it is possible to combat the rodent population, pitting human intelligence against the ubiquity, pertinacity and fecundity of these disease carriers.

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FEBRUARY ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Seasonable Operations.—Owing to the continuously sodden state of the land during the autumn and early winter, field work is backward in all parts of the country. Much land intended for winter varieties of corn could not be sown; autumn cleaning was impossible; and, favoured by the abnormally mild temperatures prevailing during November, December, and January, weeds of the twitch class continued their growth and ramification. The soft condition of the soil, not to mention the state of farm roads and gateways, has also hindered the carting out of manure even on to grassland and leys. It is obvious, therefore, that farmers are awaiting with unusual interest the advent of February,

hoping for it to bring conditions which will enable them to overtake some of the above-mentioned arrears and overcome some of the consequences of the remarkably wet and mild autumn. Apart from arrears and sowings, good conditions in February may be turned to advantage in cross ploughing, ploughing-in manure for roots and ridging up for mangolds, which require firm ridges. During this month also phosphates, potash and lime may be applied to grass land and a light dressing of yard manure should be apportioned and given to the clover crop.

February Sowings.—Doubtless the first opportunities for land work will be applied to the sowing of cereals. On the experience of recent years, especially last season, which included some unusually severe weather in February and March; winter oats have proved a very safe crop for sowing at this time of the year; and in view of the advantages of early-sown oats—freedom from frit-fly and charlock, drought resistance and earliness of ripening—it is sound policy in many districts to sow this class of corn on most of the break intended for oats. It is also a more reliable crop than spring wheat for cool situations and the less fertile soils.

Many fine crops of January and February sown winter oats, including white varieties, were observed in Derbyshire last season. At two centres situated at elevations of 700 ft. and 850 ft. respectively, winter oats sown on 31st January gave excellent results. Only one failure of whites sown at this time of the year was heard of, and enquiry revealed the fact that barley sown on the same land in March also failed, the cause of failure being wireworm. Hill farmers in particular are recommended to consider the desirability of a February sowing, if possible, as even though the crop may not be intended for thrashing, an early-ripe piece of corn is much easier to harvest than one which is still green and milky when cut in September. The white winter oat should be preferred where there is risk of lodging, but it requires heavy seeding, 5 to 6 bushels per acre. Barley also may be sown this month.

Regarding February sowing of wheat, the principal observations from last year's trials were (i) the suitability of Victor and Bearded Red and (ii) the importance of an application of a complete fertiliser at the time of seeding.

Mixed Corn and Silage Crops.—In recent years greater interest has been taken in mixed crops. Mr. J. C. Brown found that in Shropshire a mixture of peas and oats sown in early spring could be grown successfully for hay or for corn on soils

which would not give a profitable crop of oats. In Herefordshire he has found that an autumn or winter sown mixture of cereal and pulse crops produces much heavier yields of grain and fodder than any of the components sown separately. In various districts of Scotland a mixed crop of beans and oats is popular: the beans are sown in February, the oats, a late-ripening variety, being sown about three weeks later, preferably just before the beans come through the ground. The two plants together are better able to suppress weeds than are beans alone and the mixture of oats and beans is a favourite milk producing food.

For ensilage, the following mixture to be sown in early spring is recommended by the Irish Free State Department of Agriculture after trials at Glasnevin:—beans 10 st., oats 7 st., vetches 3 st., peas 2 st., per acre. The foregoing seedings are recommended for heavy land. For lighter soils part of the beans might be replaced with vetches and peas. Incidentally it may be mentioned that the Glasnevin trials also indicated the risk of continuous cropping with bean mixtures, which some experimenters have thought possible: in the third successive crop the beans failed owing to streak disease. Also it must be borne in mind that beans are susceptible to the fungus form of clover sickness.

Dual Purpose versus Dairy Cattle.—A correspondent raises the question of whether it is advisable to breed cattle entirely for milk yield, regardless of beef points. He instances the case of the Red Danish breed, in which he considers that beef qualities have been sacrificed for milking capacity to an extent that would be undesirable under British conditions.

If it be assumed that breeding for increased milk yield necessarily involves a corresponding loss of beef-producing power, and that a dairy farmer with a sale for all the milk his farm can produce is considering which of two lines to follow:—(*a*) a herd average of 650 gallons with good beef conformation, or (*b*) a herd average of 850 gallons with less regard for beef points. Which is the more profitable class of cattle under his conditions?

The difference in yield, 200 gallons at 1s. 2d. per gallon, amounts to £11 13s. 4d. per head per annum. Against this must be placed the cost of the extra food required in the production of this additional quantity of milk. Calculated at the rate of 3½ lb. of concentrates per gallon and at £11 per ton, the extra food-cost is £3 8s. 9d. In practice the additional food-cost would be less, owing to the fact that during the grazing season concentrates are less necessary, while the extra grass consumed

On the other hand there might be a little difference in the selling price of the calves marketed from the two classes of cow. It will be safe to accept the estimate that the annual advantage in favour of the higher yielder is £11 13s. 4d. less £3 8s. 9d. = £8 4s. 7d.

At the end of the cow's career in the herd, whether she is kept for five years or for a shorter period. she is fattened and sold for beef. If the 650-gallon cow weighs 12 cwt. live weight and is regarded as first quality cow-beef, her value at the present price of 46s. per cwt. would be £27 12s. 0d. If, however, the 850-gallon cow weighed only 11 cwt. live weight and was classed as second quality, her value at the present price of 39s. per cwt. would be £21 9s. 0d., which is £6 3s. 0d. less than the value of the first cow. But as the higher yielder has an advantage of £8 4s. 7d. on the milk account, there is, even when both are marketed at the end of one year, an appreciable balance in favour of the 850-gallon animal. In a regular breeding herd, however, the cow is retained on an average for about four years. During such a period the accumulated advantage on the side of the higher milk yield amounts to £32 18s. 4d., against which is to be set the difference in selling out price of about £6.

Cattle Breeding.—It has been stated that there is no scientific reason why high milk yield and superior beef properties should not coexist in the same animal. There are entire herds of home-bred cattle whose "herd average" exceeds 800 gallons, yet the cows themselves make considerably better butcher's beasts and show better indications of "constitution" than the ordinary cattle of the district, the milk yield of which probably does not exceed 600 gallons per head per annum. Up to this point the possibility of improvement in both milk and beef qualities cannot be denied. Many dairy farmers do not, however, make a systematic effort to secure these improvements, but rely on pedigree bulls of purely beef lineage or on non-pedigree bulls selected on beef conformation. The influence of the sire in raising or depressing the milk yield of his offspring is not sufficiently recognised.

In crop production it is well recognised that there are "limiting" factors: the maximum yield is limited by whatever factor of growth is least favourable. Thus on a poor or weedy soil a highly bred variety of corn would do no better and perhaps not so well as an old local sort. Similarly in cattle breeding, it is futile to attempt keeping highly developed strains under conditions where they are unable to thrive. The farmer whose pastures are sour, who stints his young cattle in winter, who

of the high-yielding cow, should not attempt to keep 1,000-galloners. On the other hand the farmer who has improved his pastures by slagging, liming, etc., and who has learnt how to rear his young stock well and to feed correctly, should reap the full advantage from his land improvements and better feeding by keeping a more productive type of cattle.

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MANURES FOR FEBRUARY.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Chalk and Crag in the Eastern Counties.—The light sandy soils of Suffolk and Norfolk are, in many cases, deficient in lime, and the question of ensuring some supply becomes important. There are several sources from which lime can be obtained, and many of the farmers have access to three: purchased lime in various forms from Stamford, Holkham, etc., chalk from chalk pits, and crag. Purchased burnt lime can be used at as low a rate as 5 cwt. per acre and will still give good results on light sandy soils if applied to the field on which roots are to be grown. A dressing of this magnitude cannot be expected to last for more than one rotation, and unless it is renewed at the next root break indications of sourness in the form of sandweed are likely to appear. Chalk from the pit must be used in considerably larger quantities, probably about 10 tons per acre if the material is soft and fine, but more is needed if it is hard and lumpy, and it should be put on before the spring. A dressing of this size lasts a long while; the writer was recently on some of Mr. E. G. Pretyman's land in East Suffolk which was chalked at about this rate thirty years ago, and is still in good condition. Crag needs to be applied in larger dressings; its value lies mainly in its content of calcium carbonate, which is very variable; some samples received in these laboratories have contained only 20 per cent. and others 50 per cent. The percentage is easily ascertained by any competent analyst, and indeed, a simple appliance has been devised by Mr. S. H. Collins that could be used by anyone who has had any laboratory training. Knowing the percentage of calcium carbonate present, it is easy to calculate how much crag must be used to supply the same quantity as does 10 tons of chalk, from which the respective costs of cragging and chalking can readily be obtained. Something must be allowed to the chalk for its softness which causes it to come more quickly into action.

Lime Deficiency and Sheep Folding.—A correspondent asks.

soil known to be near the limit in this respect. No definite experimental test of this question has been made as far as the writer knows, but the probability is that sheep folding takes less lime out of the land than do crops which are drawn off, though it removes more lime than does grass used for grazing. Much of the loss of lime is due to leaching by rainwater, and this is less on grass than on arable land.

Fertilisers on Light Soils.—The great need of light soils is for organic matter, and farmyard manure therefore stands easily first among the manurial requirements for this type of land. Of the artificial manures, potassic and nitrogenous fertilisers can be usually relied upon to give good results. Kainit (either French or German) and 20 per cent. potash salts are useful sources of potash for mangolds, peas and clovers, three crops that respond well to this type of fertiliser; while the muriate or sulphate is better suited to potatoes, the sulphate being preferable where high quality is desired.

Of the nitrogenous manures, nitrate of lime is very useful on light soils deficient in lime, as many of them are; nitrate of soda, as is well known, is equally rapid in action. Sulphate of ammonia is less useful on these soils in the absence of lime as it may then injure some of the crops, especially clover sown in the barley. If, however, lime is added during the rotation, or if the land is well chalked, this difficulty disappears.

Are Phosphates Lost by Drainage from Arable Soils?—A correspondent asks if it is true that only a small percentage of the phosphates given to crops is removed from the soil when the crop is harvested? And, if so, is the remainder washed into the soil or into the drains, or does it become insoluble? It is not correct to say that only a small percentage of the phosphate given is removed in the crop. Thus, a 32-bush. crop of wheat removes approximately as much phosphoric acid as is contained in 2 cwt. superphosphate, a 40-bush. crop of barley or a 45-bush. crop of oats removes nearly as much, 2 tons of clover hay or 15 tons of swedes remove rather more, while 25 tons of mangolds remove a good deal more. Thus, in the course of the rotation there is removed a considerable quantity of phosphoric acid.

It has to be remembered that one cwt. of 26 per cent. superphosphate contains only about 13 lb. of phosphoric acid, the terms in which phosphate content of crops is usually expressed.

It is possible that some of the water-soluble phosphate of superphosphate washes out from very light sandy soils, but it is highly improbable that any serious loss can result.

Do Mangolds Need as Much Superphosphate as Swedes or Turnips?—In discussing fertiliser problems at a recent farmers' meeting, the question arose whether mangolds need as much superphosphate as do swedes or turnips. In most cases swedes and turnips respond well to superphosphate as was shown in the early days at Rothamsted, and now on the very interesting plots at Saxmundham, where the effect of manures on the different crops of the rotation is demonstrated probably as well as anywhere in the country. It is there shown that of all the crops in the four-course rotation, swedes respond best to superphosphates, giving marked increases in yield. It is unnecessary to emphasise the advantage of having a good crop of roots in increasing the amount of stock food, and therefore of farmyard manure, which in turn enhances the fertility of the soil. As a rule, however, mangolds do not show as marked a gain. One of the plots on the mangold field at Rothamsted has received no phosphate for many years, yet the crop shows no sign of suffering in any way. The great advantage of applying superphosphate for mangolds is to ensure an early start; no fertiliser has quite so good an effect as superphosphate in stimulating early root development. If the mangold can once get started and get its roots well into the soil before spring droughts set in, it rarely fails, and so great is the advantage of ensuring this, that a dressing of 2½ cwt. per acre of superphosphate may quite well be added to the 4 cwt. of kainit, 2 to 4 cwt. of salt, and 1 to 2 cwt. of nitrate of soda that mangolds can advantageously receive. If the season turns out to be showery the superphosphate may not be needed by the crop, but it is not wasted for it remains in the soil: but if a drought should come the superphosphate may have a very valuable effect on the crop.

On the fen soils, however, mangolds respond well to superphosphate, and in some cases as much as 6 cwt. per acre has proved profitable.

Can Mineral Phosphates or Basic Slag Replace Superphosphate for Arable Crops?—A farmer writes that he is offered mineral phosphate, 80 per cent. fineness, 60 per cent. total phosphate, at less price per ton than 30 per cent. superphosphate, and he asks whether he should use it in preference to the superphosphate to which he is accustomed. The soil is light, lacking in lime, and the rainfall is 45 in. per annum.

It is always unsafe to attempt general rules in agriculture, but in many cases superphosphate has proved to be the safest phosphatic fertiliser on arable land, especially in dry conditions, and on the swede or turnip crop where rapid action is required.

But mineral phosphate, especially Gafsa phosphate ground to pass the 120 mesh sieve, has often been found effective on medium and heavy soils, especially those deficient in lime and so situated that drought is not likely to occur. In Northumberland the mineral phosphate is applied with advantage to the barley in which a seeds mixture containing wild white clover is sown; the barley gains an advantage while the clover markedly benefits. In the West Country under moderately high rainfall, basic slag and mineral phosphates have given good results on swedes. As against this, however, basic slag last year gave no important increase in yield of mangolds at Mr. E. D. Simon's farm at Leadon Court, Hereford, a result quite in accordance with what is stated in the preceding paragraph, there having been no drought this season at Leadon Court.

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending January 14th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 0	13.17	13.12	13 7	17. 3
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13. 7*	13. 7*	13. 7*	13. 7*	(N)12.11
„ „ „ neutral (N. 21.1 per cent.)	14.10*	14.10*	14.10*	14 10*	(N)13. 9
French Kainit (Pot. 14 per cent.)	2.15	2.10	2. 7	2. 7	3. 5
„ „ (Pot. 20 per cent.)	2.19	2.15	...	2,12	2. 7
Potash Salts (Pot. 30 per cent.) ...	...	...	...	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.17	2.10	2. 6
Muriate of Potash (Pot. 50 per cent.) ...	...	7. 5	7. 5	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	11.10	11. 5	4. 8
Basic Slag (T.P. 30 per cent.)	3. 2§	...	2 12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2 10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.) ...	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
„ (S.P. 30 per cent.) ...	3. 7	3. 5	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8.10	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	7. 0†	7. 7†	6. 5	6. 7†	...
Fish Guano (N. 7½-8¼. T.P. 16-20 per cent.)	...	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ..	...	...	...	13. 7	...
Burnt Lump Lime	1. 8	1.17	1.18	2. 2§	...
Ground Lime	1.14	2. 7	2. 8	1.16§	...
Ground Limestone	1. 1	...	1. 4	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Animal Nutrition Institute, Cambridge University.

Farm Values.—The farm value table has been enlarged this month by the inclusion of beans, bean straw, wheat straw, barley straw and milk. The writer from time to time has received criticisms about the prices quoted in this table. Correspondents have pointed out that the prices given in this table differ widely from the market price, and very often bear no relation to the cost of production. It may, therefore, be advisable to state the object of giving these figures, and to point out how they are intended to be of value to the farmer. The value of home-grown feeding stuffs has always been a vexed question. For valuation purposes it is often customary to allow two-thirds of the market value. This is an arbitrarily agreed figure, and is fair in the sense that a price operating adversely to the in-going tenant operates in a correspondingly beneficial sense when he becomes the outgoing tenant. Market price, however, gives an untrue indication of the value of the commodity, in the sense that whereas, owing to local advantage, one farm is able to dispose of its straw at the price quoted, another farm, say an outlying fen farm, may not be able to dispose of its straw at any price. Home-grown feeding stuffs, unless disposed of in an advantageous market, must be fed to the farm animals and so disposed of as meat, milk or work. An alternative method of assessing the farm value of a home-grown feeding stuff is to assess it at cost of production. This, however, is also an unsatisfactory method, since the cost of production of a feeding stuff not only varies considerably from farm to farm, but also varies from year to year on the same farm, chiefly owing to fluctuating annual yields. Since neither the market price nor the cost of production forms reliable indication of the value of home-grown feeding stuffs on all farms, and since the home-grown feeding stuff is either marketed or fed on the farm, the writer adopted a third method of assessing the farm value which has the advantage of bearing some relationship to the food value of the commodity in question, and is based on the price paid for purchased feeding stuffs. The method of arriving at the price is as follows :—The unit value of a feeding stuff of similar, or somewhat similar character, is obtained from the current prices table, and is multiplied by the number of starch equivalents in the feeding stuff in question; the manurial value is then

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British	—	—	13/6	13 10	0 15	12 15	71·6	3/7	1·92
Barley, British Feeding	—	—	12/3	12 5	0 12	11 13	71	3/3	1·74
„ Canadian :—									
No. 3 Western	44/–	400	12/4	12 7	0 12	11 15	71	3/4	1·78
„ 4 „	43/–	„	12/0	12 0	0 12	11 8	71	3/3	1·74
„ American	42/9	„	11/11	11 18	0 12	11 6	71	3/2	1·70
„ Danubian	43/3	„	12/1	12 2	0 12	11 10	71	3/3	1·74
„ Karachi	*41/–	„	11/6*	11 10*	0 12	10 18	71	3/1	1·65
Oats, English, White	—	—	10/10	10 17	0 13	10 4	59·5	3/5	1·83
„ „ Black and Grey	—	—	9/9†	9 15†	0 13	9 2	59·5	3/1	1·65
„ Scotch White	—	—	11/4	11 7	0 13	10 14	59·5	3/7	1·92
„ Canadian :—									
No. 2 Western	37/–	320	12/11	12 18	0 13	12 5	59·5	4/1	2·19
„ 3 „	36/3	„	12/8	12 13	0 13	12 0	59·5	4/–	2·14
Maize, Argentine	48/9	480	11/4	11 7	0 13	10 14	81	2/8	1·43
Beans, English Winter	—	—	11/–	11 0	1 12	9 8	67	2/10	1·52
Peas, English Maple	—	—	12/11	12 18	1 8	11 10	69	3/4	1·78
„ Japanese	—	—	24/3†	24 5†	1 8	22 17	69	6/7	3·53
Rye, Homegrown	—	—	11/3	11 5	0 15	10 10	71·6	2/11	1·56
Dari, Egyptian	—	—	11/3	11 5	0 15	10 10	75·2	2/10	1·52
„ Persian	—	—	12/6	12 10	0 15	11 15	75·2	3/2	1·70
Millers' Offals :—									
Bran, British	—	—	—	8 12	1 6	7 6	45	3/3	1·74
„ Broad	—	—	—	10 0	1 6	8 14	45	3/10	2·05
Middlings—									
Fine Imported	—	—	—	11 2	1 2	10 0	72	2/9	1·47
Coarse, British	—	—	—	10 0	1 2	8 18	64	2/9	1·47
Pollards, Imported	—	—	—	8 15	1 6	7 9	60	2/6	1·34
Meal, Barley	—	—	—	13 10	0 12	12 18	71	3/8	1·96
„ Maize	—	—	—	11 12	0 13	10 19	81	2/8	1·43
„ „ South African	—	—	—	11 5†	0 13	10 12	81	2/7	1.38
„ „ Germ	—	—	—	11 5	0 19	10 6	85·3	2/4	1·25
„ „ Gluten Feed	—	—	—	11 5	1 7	9 18	75·6	2/7	1·38
„ Locust Bean	—	—	—	9 15	0 9	9 6	71·4	2/7	1·38
„ Bean	—	—	—	14 0	1 12	12 8	67	3/8	1·96
„ Fish	—	—	—	21 0	4 5	16 15	53	6/4	3·39
Linseed	—	—	—	24 15	1 11	23 4	119	3/11	2·10
„ Cake, English 12°/o Oil	—	—	—	14 10	1 18	12 12	74	3/5	1·83
„ „ 10°/o Oil	—	—	—	13 17	1 18	11 19	74	3/3	1·74
„ „ 9°/o Oil	—	—	—	13 15	1 18	11 17	74	3/2	1·70
Cottonseed Cake, English 5½°/o Oil	—	—	—	8 12	1 14	6 18	42	3/3	1·74
„ „ Egyptian 5½°/o Oil	—	—	—	8 10	1 14	6 16	42	3/3	1·74
Decorticated Cotton Seed Meal 7% Oil	—	—	—	12 17	2 13	10 4	74	2/9	1·47
Palm Kernel Cake 6°/o Oil	—	—	—	9 5†	1 3	8 2	75	2/2	1·16
„ „ Meal 2°/o Oil	—	—	—	8 2	1 4	6 18	71·3	1/11	1·03
Feeding Treacle	—	—	—	7 15	0 8	7 7	51	2/11	1·56
Brewers' Grains :—									
Dried Ale	—	—	—	9 12	1 4	8 8	49	3/5	1·83
„ Porter	—	—	—	9 2	1 4	7 18	49	3/3	1·74
Wet Ale	—	—	—	1 10	0 9	1 1	15	1/5	0·76
„ Porter	—	—	—	1 7	0 9	0 18	15	1/2	0 62
Malt Culms	—	—	—	8 10†	1 14	6 16	43	3/2	1·70

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this

added, and the resultant figure gives a comparative value per ton of the feeding stuff in question for consumption on the farm. Thus, for potatoes, maize, as a starchy food, is used for comparison. The value per unit of S.E. of maize is 2s. 8d. Potatoes contain 18 units starch equivalent and have a manurial value of 4s. The value per ton of potatoes if consumed on the farm is therefore (18 × 2s. 8d.) + 4s. =£2 12s. What is the value of this figure, and how can it be used? On a starch equivalent basis 1 ton of maize is equivalent to 4½ tons of potatoes. Now, maize per ton is £11 7s. Allowing 20s. a ton for carriage and cartage and 10s. for grinding, a ton of maize on the farm would cost £12 17s. Allowing, therefore, for transport costs of the imported feeding stuffs, with maize at £12 17s. delivered, potatoes would be worth £2 17s. a ton. If, therefore, potatoes could be sold ex-farm at more than £2 17s. a ton then it would pay to sell the potatoes and buy in an equivalent amount of maize if required for feeding. If, on the other hand, the price ex-farm was less than £2 17s. a ton, it would not be a paying proposition to sell the potatoes and buy in other feeding stuffs, since a loss is bound to result from the transaction. The farm value as given serves another purpose. If the farmer knows the cost of production, this figure gives him a guide as to whether he is producing his home-grown feeding stuffs on an economical basis. Thus, if the cost of production of potatoes is say £5 per ton, it is obviously uneconomic to grow potatoes for feeding stock, since the value of potatoes for feeding is only £2 12s. a ton. On the other hand, with the cost of production of hay at say 30s. a ton, it is obviously economic to produce hay for stock feeding, since its value for this purpose is £5 19s. a ton.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat - - - - - -	1·43	2 8	71·6	9 11	0 15	10 6
Oats - - - - - -	1·43	2 8	59·5	7 19	0 13	8 12
Barley - - - - - -	1·43	2 8	71·0	9 9	0 12	10 1
Potatoes - - - - -	1·43	2 8	18·0	2 8	0 4	2 12
Swedes - - - - -	1·43	2 8	7·0	0 19	0 2	1 1
Mangolds - - - -	1·43	2 8	6·0	0 16	0 3	0 19
Beans - - - -	1.43	2 8	67.0	8 19	1 12	10 11
Milk - - - - -	3.39	6 4	17.1	5 9	0 4	5 13
Good Meadow Hay - -	1·83	3 5	31·0	5 6	0 13	5 19
Good Oat Straw - - -	1·83	3 5	17·0	2 19	0 7	3 6
Good Clover Hay - -	1·83	3 5	32·0	5 9	1 0	6 9
Vetch and Oat Silage - -	1·61	3 0	14·0	2 2	0 7	2 9
Barley Straw -	1·83	3 5	19·5	3 7	0 6	3 13
Wheat Straw - - -	1·83	3 5	11·0	1 18	0 4	2 2
Bean Straw - - - -	1·83	3 5	19·0	[illegible]	[illegible]	[illegible]

Early Maturity in Beef Production.

IT is a significant fact that, although the Smithfield Club held its first Show in 1799, it was not till 1881 that the championship for a beef animal was awarded to one under three years old, and it was exactly a century after the first Show (that is in 1899) that a cup was awarded for the best animal under two years old. Finally, within the past few years, competition classes have been instituted for beef cattle under 15 months old.

This tendency meets the public demand for prime beef and small joints. It is also in the interests of economy in production, and it is clearly good business for feeders to pay more attention than ever to finishing off stock at an early age. Gain in weight is made more rapidly and more cheaply by a young animal than by an older one, because more food is required for mere maintenance in an older animal and less is therefore available for the production of flesh and fat.

In feeding for early maturity, the aim should be to stimulate growth (which is largely flesh formation) and fattening at the same time, so that the animal arrives at a suitable stage of size and fatness in the least possible period. For this purpose, easily digestible foods relatively rich in protein, such as linseed cake, are necessary. It is, however, equally important that the animal should have inherited the requisite capacity for quick growth. This is inherent in certain breeds and crosses, and if one may judge by the results in the younger classes at Smithfield, the cross-breds, usually Aberdeen Angus-Shorthorn crosses, are superior to the pure progeny of either breed in respect of this quality of quick growth.

It may be doubted whether the feeding of animals for the leading fat stock Shows is always, or even generally, a very profitable proceeding, but the man who rears the best class of stock for other people to bring out for show does often derive considerable monetary benefit. From time to time during the autumn, one saw reported in the agricultural press, Northern sales of weaned calves, 8 to 10 months old, at prices ranging up to £30 apiece. Many private sales of the same class of stock also occur at equally remunerative prices, of which, however, no record is published. These refer to suckled calves, mostly of Angus-Shorthorn breeding. The famous blue-greys are generally the result of crossing Angus and Galloway cows with a white Shorthorn bull. Equally saleable cattle, not necessarily of blue-grey colour, may be produced by using an Angus bull on Short-

Shorthorn cow is usually a better milker than the Angus or Galloway and the calves are, consequently, better done and command higher prices.

Although this system of calf-rearing is mainly confined to the North, there would seem to be no reason why it should not be conducted with equal, if not greater, success in the South. There is plenty of second-rate grassland in England suitable for the purpose on which Shorthorn cows or heifers could be run cheaply out-of-doors all the year round, and be made to rear one or more calves apiece, annually. In the North suitable cattle for the purpose, other than Galloways, have to be housed and hand-fed during the winter at correspondingly greater expense.

Not all calves so reared will be fit for exhibition purposes, but they will always be readily saleable, as, owing to the spread of dairying and the ever-increasing popularity of animals that are bred essentially for milk, there is a real scarcity of well-fleshed good-doing store cattle.

* * * * * *

Results of the Marketing of Yeoman II Seed Wheat.

THE Council of the National Institute of Agricultural Botany recently issued the following statement respecting the distribution of Yeoman II seed wheat. 712 acres were sown on 30 farms, mainly in Essex and Herts, in the autumn of 1923. Reports received up to the end of June suggested that the total crop of seed would be between two and three thousand quarters. It had been contemplated from the foundation of the Institute that the seed of new varieties when ready for sale should be offered to established dealers only and not direct to farmers, for the sale of any large quantity of seed in small lots would require an extensive organisation which it would be quite uneconomical, if not impossible, to form and disband on each occasion that the Institute had a new variety to market. In the seed merchants of the country there already exists an efficient system for the advertisement and distribution of new varieties, and the experience gained in handling the Yeoman II wheat has confirmed the Council in their conviction that by using the system ready to hand they have secured a more rapid, more efficient, more widespread and more economical distribution than if they had attempted to improvise a new system of their own for direct sale to farmers. Accordingly, early in July a letter was sent to all members of the Agricultural Seed Trade Association, the National Associa-

tion of British and Irish Millers, and to the Council of the National Association of Corn and Agricultural Merchants, who circulated it to their members, announcing that the Institute would invite tenders as to quantity for about 2,500 quarters from established dealers in seed corn. The conditions of sale stated that deliveries on account of allotments would be subject to the 1924 crop being fit for seed. The only unusual condition was that purchasers were required when reselling to give a preference to Fellows of the Institute. Merchants were free either to re-sell in the same unbroken bags or to sow themselves with a view to selling their 1925 crop. It is understood that the greater portion of the 1924 crop was re-sold to farmers, but the Council are glad to know that some portion was sown by merchants themselves, as this should ensure an ample supply of seed in 1925.

The Institute fixed the price to the farmer at £6 6s. per quarter less 5 per cent. discount for cash. A further discount was allowed to merchants sufficient to cover their costs in advertising and handling the wheat and leave them with a fair profit for their trouble. The price was thus the same for all purchasers. In settling the price the Council took into account the costs of growing, cleaning and distributing the wheat. Had they attempted to recover the whole costs of breeding and testing the price must have been on a level which no farmer could pay. Fortunately, this was unnecessary, as these costs are met by Government grants and subscriptions from the general public.

The total quantity for which tenders were received before the closing date, 1st August, was unexpectedly large; but the appearance of the crops at the end of July and beginning of August promised, with normal weather, at least 3,200 quarters of seed, and as this was just half the quantity tendered for, allotment was made on that basis.

Unfortunately, the weather was far worse than usual. The effects on Yeoman II were that only one crop of 6 acres could be thrashed from the field, some portions were actually destroyed before they could be carted, and the carting of the last crop did not finish till October. Consequently, it was five or six weeks later than had been hoped before the wheat could be thrashed in any quantity, and then a great deal of the grain proved to be unfit for seed. The last of the wheat was not thrashed until the 24th November. The Institute arranged to have the wheat cleaned by seven firms situated in the growers'

districts, as it would have been uneconomical for the Institute at the present stage to erect its own cleaning plant capable of dealing with thousands of quarters. The arrangements proved to be generally satisfactory, though the unfortunate season made the work of cleaning unusually long and trying. The interference with the ordinary trade of some of these firms was therefore considerable, and the Institute is correspondingly indebted to them for their loyal assistance.

The seed began to be sent out in the middle of September, but not in any quantity until the end of the month. As several members of the Council had themselves tendered for the wheat, the order of delivery was left entirely to the discretion of the Director, who decided that delivery should be made as far as possible in the order in which tenders were received, but that firms which had been allotted more than 75 quarters should receive their wheat in from two to five instalments at regular intervals. As there were 105 merchants, each with many customers of his own, wanting the wheat and seven warehouses to deliver from, this principle could not be followed without exceptions; but these were few and were made for good reasons of convenience. No preference of any kind was given to any merchant on account of connection with or assistance given to the Institute.

A further complication was caused by the fact that the quantity of grain delivered from the first 250 acres came up to expectations. Delivery was therefore made in full for some weeks. Later, however, the effects of the weather became apparent in the reduced receipts of saleable grain. By the middle of October it was clear that there would not be enough seed to complete deliveries in full. The Council were therefore forced to offer the remaining merchants the alternatives of accepting half the quantity allotted but not yet delivered or of cancelling their applications altogether.

The delivery of the reduced quantities was completed by the middle of November. 2,373 quarters had then been sent out. There was left a stock of about 285 quarters, and this was advertised and offered by letter at the original price to all the merchants to whom the wheat had originally been allotted. A further 106 quarters was sold in this way by the middle of December when the autumn demand came to an end.

There remained at the date of the notice, 31st December, 1924, a stock of about 180 quarters. As the wheat can be sown with reasonably good prospects of success up to the

middle of February, the Institute was prepared to receive any orders sent through merchants before that date. Any balance then on hand will be sold to the mills.

It will be understood that the reduction of allotments and delays in delivery caused considerable inconvenience and disappointment to many merchants and farmers. These difficulties were due to the weather, and the weather alone, and no effort was spared by growers, cleaners and the Institute to effect prompt delivery in full to every customer. In the circumstances the Council regard the delivery of 2,480 quarters of sound seed of an improved wheat as a very satisfactory achievement, and they wish to record their gratitude both to the farmers who grew the crop and to the merchants whose co-operation secured its prompt and widespread distribution.

* * * * * *

Raspberry Cultivation in the Netherlands and Switzerland.

THE cultivation of the raspberry is not considered to be a very important industry in Holland. The principal varieties cultivated are the Superlative and the Hornet. In a few districts the so-called "Brown Hague" is grown, but it cannot compete with either of the two varieties previously mentioned. Superlative gives the largest yield, but owing to its short blossoming period night frosts often damage the crop. Hornet has a longer blossoming period, and its cultivation is therefore less risky. Damage to both varieties by insect pests is equal. Both varieties can stand the usual Dutch frosts. The principal raspberry growing area is in the neighbourhood of Breda, where a yield of about 2 tons per acre is considered a normal crop.

In Switzerland the principal varieties grown are "Winkler's Sämling," Superlativ and Fastolf, and, to a small extent only, Marlborough, Harzjuwel and Goliath. During the last twenty years Winkler's Sämling has proved the most profitable variety on account of its yield, the beauty of its fruit and its ability to withstand the winter. In trials conducted at Wädenswil this variety gave the greatest yield, followed by Harzjuwel and Marlborough. All varieties, and, unfortunately, Winkler's Sämling in particular, have suffered from the ravages of a fungus (*Didymella applanata*) which has destroyed some plantations almost entirely. It appears, however, that in some districts canes have recovered from these attacks. At Wädenswil, the varieties Marlborough and Goliath have been practically free from this pest, and it is possible that under favourable conditions of cultivation Winkler's Sämling might also escape.

The Sale of Seed Potatoes.

A FIRM of Scottish seed potato merchants was recently convicted of an offence under the Seeds Act, 1920, in respect of the sale of a consignment of 2 tons of "Sharpe's Express" seed potatoes with an incorrect description of the variety.

The Seeds Act, 1920, and the Seeds Regulations, 1922, require, in the case of a sale of seed potatoes, that the seller shall make a statement in writing to the purchaser at, or before the time of sale or delivery, containing particulars as to the class, variety, size and dressing of the potatoes. The name of the variety in this connection is not taken to be incorrectly stated if it is true in respect of 97 per cent. of the total quantity sold. In the case in question the seed potatoes were estimated to have contained approximately 30 per cent. of "rogues." The defendants pleaded guilty and a fine of £5 was imposed.

A pamphlet (Form No. A. 64/H.D.) containing a summary of the Wart Disease of Potatoes Order, 1923, and of the Seeds Act, 1920, and the Seeds Regulations, 1922, so far as they affect the sale of seed potatoes, may be obtained free of charge on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1.

* * * * * *

Prohibition of Importation of Potatoes from the United States of America.

THE 1924 crop of potatoes in the United States of America has been so plentiful that export markets for the surplus are being sought, and small quantities have already been sent to this country.

Unfortunately, the potato fields over large areas of the United States are infested with the destructive Colorado beetle—a pest of which the introduction into this country must be guarded against as far as possible. It will be remembered that the Colorado beetle established itself during recent years in a small district of France, and the Ministry then felt compelled to prohibit by Order the importation of potatoes from that area, for so long as the pest exists. The importation of potatoes from the United States is attended with equal risks, and the Ministry feels it necessary similarly to exercise its powers under the Destructive Insects and Pests Acts and to prohibit the importation of potatoes from there.

An Order entitled "The Colorado Beetle Order of 1924" has accordingly been issued, under which the importation into England and Wales of potatoes grown in the United States is

prohibited. The Order came into operation on the 23rd December, 1924, but provision was made for the admission of any consignments that might already have been shipped.

Similar Orders have since been issued by the Board of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland. The importation of potatoes into the Irish Free State is prohibited except under licence, and the Ministry understands that licences would not be issued by the Department of Agriculture, Dublin, for the importation of potatoes from the United States.

* * * * * *

Removing Tags from Imported Animals.

A CASE of considerable interest to agriculturists was heard recently at the Leed's Assizes. It was a charge of conspiracy against two cattle dealers to defeat the provisions of Orders under the Diseases of Animals Acts made to regulate the movement of imported animals so as to prevent the spread of disease. Cattle imported into Great Britain under these Orders (*i.e.*, from Ireland and Canada) are marked at the authorised landingplace by a tag inserted in the ear. The tag bears a serial number which serves as a means of identifying the animal subsequently at its place of detention, and thus facilitates the tracing of animals should a case of foot-and-mouth disease occur.

In the case in question, the two cattle dealers were found to have removed some of the tags on animals which were undergoing detention, and to have fixed them to the ears of other animals which were intended to remain on the farm. This enabled the imported animals to be taken to market earlier than was allowable under the regulations, thus defeating their object.

The dealers were found guilty of conspiracy to break the regulations and were fined £25 each, Mr. Justice Branson remarking that as this was the first case of the kind he did not propose to make an example of the defendants.

* * * * * *

Potato Moth in English Potatoes: Incorrect Report.

THE Annual Letter of Information, No. 37, from the Federal Horticultural Board of the United States Department of Agriculture contained a statement that potato moth had been discovered in potatoes consigned from England. This record was challenged by the scientific officers of the Ministry of Agriculture, and a closer inquiry, which was courteously made

at once by the United States Department, revealed the fact that the report was almost certainly erroneous. Potatoes infested with the tuber moth had been found in the stores of a British ship which arrived in Philadelphia in December, 1923, but she had come from London, *viâ* Tampico, Mexico, and had taken potatoes on board at that port. In the circumstances, and since the Department could be assured that the potato moth is not present in this country, the United States Department decided that it appeared to be safe to assume that the infested potatoes had been taken on board in Mexico.

* * * * * *

Fertilisers and Feeding Stuffs Act, 1906.

THE Report of the Departmental Committee on the Fertilisers and Feeding Stuffs Act, 1906 (Cmd. 2125), presented to the Minister of Agriculture and Fisheries in March last, recommends far-reaching alterations in the machinery to prevent adulteration and misdescription of fertilisers and feeding stuffs.

One of the suggestions of the Departmental Committee was that, if the general proposals contained in the Report were accepted, a further Committee should be set up, whose principal function should be to frame schedules setting out the articles to which revised legislation should apply, the definition of each of these articles and the particulars to be stated in the invoice and also in the description applied to the article, in each case.

This Advisory Committee, which has power to co-opt, was constituted in December last as follows:—

The Lord Clinton (Chairman).	Mr. J. W. Pearson.
Mr. E. G. Haygarth-Brown.	Mr. R. R. Robbins, C.B.E.
Dr. Charles Crowther, M.A., Ph.D.	Sir E. J. Russell, O.B.E., D.Sc., F.R.S.
Mr. J. Garton.	
Mr. C. W. Higgs.	Mr. John Speir.
Mr. Arthur Holgate.	Mr. George Stubbs, C.B.E. F.I.C.
Mr. Thomas Kyle.	Dr. J. F. Tocher, D.Sc., F.I.C.
Mr. Alexander Main, M.A., B.Sc.	Professor T. B. Wood, C.B.E., M.A., F.I.C., F.R.S.
Lt.-Col. R. L. Norrington, C.M.G.	

Mr. H. Johns (Secretary).

The terms of reference are:—

1. To draw up Schedules for the purpose of prescribing—

(*a*) The fertilisers and feeding stuffs to which all the provisions of proposed legislation on the lines of the Report of the Departmental Committee on the Fertilisers and Feeding Stuffs Act, 1906, should apply, and those to which only the civil provisions of such legislation should apply;

(*b*) Definitions of each of the articles or classes of articles mentioned above:

(c) The statements as to the constituents present, and also as to the absence of certain substances in some instances, which should be given in descriptions and invoices;

(d) Those commodities which should be regarded as "worthless" or "deleterious."

2. To recommend the terms in which the valuable constituents should be stated in descriptions and invoices.

* * * * * *

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on the 13th January, at 6, Richmond Terrace, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from various Agricultural Wages Committees of their resolutions fixing minimum rates of wages, and proceeded to make the necessary Orders carrying out the Committees' decisions and specifying the date from which the rates shall become effective. The date specified was 26th January in each case (with the exception of the Orders for the overtime rates in certain areas as mentioned below).

The rates thus fixed are, in the case of adult male workers, as follows:—

Bedford and Huntingdon.—Until 29 March, 1925, 29s. for a week of 48 hr., overtime 9d. per hr. on weekdays, 10d. on Sundays.

Cambs and Ely.—Until 28 Feb., 1925, horsemen, cowmen, and shepherds, 37s. per week (for the hours necessary for the performance of customary duties); other adult male workers, 30s. per week of 48 hr., overtime 9d. per hr.

Cumberland and Westmorland.—Until 30 May, 1925, workers hired on half-yearly or yearly engagements, 37s. per week of customary hours; other adult male workers (except casual workers), 30s. per week of 48 hr. in winter (1 Nov. to last day of Feb.), and of 54 hr. in summer (remainder of the year); casual workers, 7½d. per hr. Overtime rates for each class 8d. per hr.

Dorset.—For six months from the date of operation, 30s. per week of 51 hr.

Hereford.—Until 30 April, 1925, 31s. per week of 48 hr. in winter (Nov., Dec., Jan.) and 52 hr. in summer (remainder of the year). Overtime 7¼d. per hr. for overtime between 6 a.m. and 6 p.m. Other weekday overtime at time-and-a-quarter, that rate and all Sunday employment at time-and-a-half that rate.

Middlesex.—For twelve months from the date of operation, stockmen, 41s. 3d. for a week of 60 hr.; carters, 38s. 6d. for a week of 56 hr.; other regular workers, 33s. for a week of 48 hr. in winter (1 Nov. to last day of Feb.) and 34s. 4½d. for a week of 50 hr. in summer (remainder of the year); casual workers, 8¼d. per hr. Overtime rate in each case 10½d. per hr.

Suffolk.—7d. per hr. for a guaranteed week of 50 hr. in summer (first Monday in March to the last Sunday in Oct.) and of 48 hr. in winter (remainder of the year), with, in the case of

horsemen, stockmen, and shepherds, an additional inclusive weekly sum of 6s. to cover duties in connection with the care of animals. Overtime rates 9d. per hr.

Worcester.—30s. for a week of 53 hr. in summer (first Monday in March to last Sunday in Oct.), and 48 hr. in winter (remainder of the year). Overtime at time-and-a-quarter the general minimum rate.

In Hereford, Middlesex and Worcester, the overtime rates cannot become operative until the Committees for those areas have confirmed their proposed Orders defining the employment to rank as overtime employment.

The Board also made Orders for overtime rates for three areas for which general minimum rates were already in force, viz., Berkshire (the overtime rate for adult male workers to be 8½d. per hr.), Essex (one-and-a-quarter times the general minimum rate), and Norfolk (9d. per hr. on weekdays and 10½d. on Sundays for adult male workers). These overtime rates will come into operation in Essex and Norfolk on 26 Jan., and in Berkshire on the same date if the Committee has by then defined overtime employment.

The Orders made as above include also minimum and overtime rates for male workers under 21, and in the cases of Beds. and Hunts., Cumberland and Westmorland, Middlesex and Worcester, minimum rates for female workers.

The next meeting of the Board will be held on Tuesday, 27th Jan., 1925.

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Notices of Proposals to Fix Minimum Wages.

IN the cases of twelve Agricultural Wages Committees minimum rates have already been fixed (see above and p. 889 of *Journal* for January, 1925). The remaining thirty-five Committees have all arrived at preliminary decisions with regard to certain of the rates they propose to fix, and brief particulars are gives below of the various notices of proposals affecting adult male workers advertised up to the 27th January:—

Buckingham.—30s. for 50 hr. in summer and 48 hr. in winter, until last Saturday in Oct., 1925.

Cheshire.—35s. for 54 hr., until 31 Oct., 1925.

Derbyshire.—8d. per hr. for a guaranteed week of 54 hr., until 15 Dec., 1925.

Durham.—32s. for 50 hr.; horsemen, 32s. for 50 hr., with additions for extra time spent in attention to horses; stockmen and shepherds, for customary hours, 36s. to 43s. per week, until 13 May, 1925.

Gloucester.—30s. for 50 hr. Various rates for carters, stockmen and shepherds, until 11 Oct., 1925.

Hampshire and Isle of Wight.—30s. for 51 hr. in summer and 48 hr. in winter, until 11 Oct., 1925.

Hertfordshire.—$7\frac{3}{4}$d. per hr. for a guaranteed week of 48 hr.

Kent.—32s. 6d. for 52 hr. in summer and 48 hr. in winter for 12 months.

Lancashire: E. Area.—42s. for 60 hr.

Lancashire: N. Area.—37s. 6d. for 60 hr.; stockmen and teamsmen, 40s. for 60 hr.

Lancashire: S. Area.—33s. 6d. for 50 hr.; stockmen and teamsmen, 37s. for 52 hr.

Leicester and Rutland.—34s. in Leicester and 32s. 6d. in Rutland for 54 hr., until 31 Oct., 1925.

Lincs.: Holland.—36s. for a week of 48 hr., until 4 April, 1925.

Lincs.: Kesteven and Lindsey.—32s. for 52 hr. in summer and 48 hr. in winter; shepherds, stockmen and horsemen, addition of 5s., 6s., and 7s. per week respectively for extra hours spent in attendance to animals, until 1 Nov., 1925.

Monmouth.—32s. for 48 hr. in winter and 50 hr. in summer, for 12 months.

Northants and Soke of Peterborough.—30s. for 50 hr. in summer and 48 hr. in winter.

Northumberland.—34s. for $52\frac{1}{2}$ hr. in summer and 48 hr. in winter; horsemen and cattlemen 41s. for 62 hr., until 12 May, 1926.

Nottingham.—32s. for 50 hr., until 31 Oct., 1925.

Oxford.—30s. for 50 hr. in summer and 48 hr. in winter, until 31 Oct., 1925.

Shropshire.—31s. for 54 hr.

Somerset.—32s. for 52 hr.

Stafford.—7d. per hr. for a guaranteed week of 54 hr., until 27 June, 1925.

Surrey.—32s. 3d. for 50 hr.; stockmen, shepherds and horsemen, 38s. 8d. for 60 hr., to continue until cancelled or varied.

Sussex.—30s. for 52 hr. in summer and 48 hr. in winter.

Warwick.—30s. for 50 hr. in summer and 48 hr. in winter, until last Saturday in Oct., 1925.

Wiltshire.—30s. for 50 hr., until 11 Oct., 1925.

Yorks, East Riding.—34s. for $52\frac{1}{2}$ hr. in summer and 48 hr. in winter; various rates for special grades; until 23 Nov., 1925.

Yorks, North Riding.—33s. for $52\frac{1}{2}$ hr. in summer and 48 hr. in winter, until 25 Oct., 1925.

Yorks, West Riding.—36s. for $52\frac{1}{2}$ hr. in summer and 48 hr. in winter; special rates for horsemen, beastmen and shepherds; until 23 Nov., 1925.

Carmarthen.—30s. for 54 hr., until 14 Nov., 1925.

Denbigh and Flint.—30s. 6d. for 50 hr.; teamsmen, cattlemen, cowmen, shepherds and bailiffs of 21 years and over, 37s. for 61 hr. (including Sunday); for 12 months.

Glamorgan.—37s. 6d. for 53 hr. in summer and 51 hr. in winter, until 1 March, 1926.

Merioneth and Montgomery.—31s. for 54 hr.; stockmen, teamsters and shepherds of 21 years and over, 34s. for 60 hr.; until 1 May, 1925.

Pembroke and Cardigan.—30s. for 54 hr. in summer and 50 hr. in winter, for 3 months.

Radnor and Brecon.—31s. for 52 hr. in summer and 50 hr. in winter, until 2 April, 1925.

Foot-and-Mouth Disease. — There was no fresh outbreak of foot-and-mouth disease from 18th December, when an outbreak occurred at Wellingborough, Northants, to the 12th January, when disease re-appeared at Stoke Bardolph, near Nottingham.

This new outbreak necessitated the imposition of restrictions of the usual type to an area within a wide radius of the infected place.

All other restrictions in connection with the earlier outbreaks in Norfolk and Northants were removed on 7th and 15th January, 1925, respectively.

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Instruction in Milk Recording. — The University College, Reading, will, as in previous years, hold a short course in milk recording, which will take place from 3rd to 21st March. The fee for tuition will be £3, and applications to attend should be forwarded, by 26th February at the latest, to the Dean, Faculty of Agriculture, University College, Reading.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Schreiber, C.—Le Sol et les Engrais. Tome I: Le Sol. (170 pp.) Gembloux: Duculot, 1924. (Bibliothèque Agronomique Belge, No. 3.) [63.11.]

Cunningham, A.—Practical Bacteriology: An Introductory Course for Students of Agriculture. (194 pp.) Edinburgh and London: Oliver & Boyd, 1924, 7s. 6d. net. [576.8.]

Berry, J. B.—Teaching Agriculture. (244 pp.) Chicago: World Book Co.; London: G. G. Harrap & Co., 1924, 5s. net. [37.]

Canada Department of Agriculture.—The Organisation, Achievements and Present Work of the Experimental Farms. (302 pp.) Ottawa, 1924. [37(072) (71).]

Field Crops.

Leeds University and the Yorkshire Council for Agricultural Education.—Report No. 136:—Experiments with Seeds Mixtures in the North Riding of Yorkshire. (36 pp.) Leeds, 1924. [63.33(a).]

Connecticut Storrs Agricultural Experiment Station.—Bull. 119:—Spacing of Potato Hills. (pp. 141-151.) Storrs, 1924. [63.512.]

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Nebraska Agricultural Experiment Station.—Research Bull. 24:—Seed Potato Investigations. (58 pp.) Lincoln, 1923. [63.512.]

Horticulture and Fruit Growing.

International Horticultural Congress (1923).—Verslag van het Internationaal Tuinbouw-Congres, Amsterdam, 17-23 September, 1923. (260 pp.) Koninklijke Nederlandsche Maatschappij voor Tuinbouw en Plantkunde. [63.5.]

Rohde, E. S.—The Old English Gardening Books. (152 pp. + 16 pl.) London: Martin Hopkinson & Co., 15s. [63.52.]

Beale, R.—Lawns for Sports: Their Construction and Upkeep. (276 pp. + 30 pl.) London: Simpkin, Marshall, Hamilton, Kent & Co., 1924, 12s. 6d. net. [63.521.]

Fletcher, F. J.—Cut Flowers for Market. (64 pp.) London: Ernest Benn, 1924, 2s. 6d. net. [63.52.]

U.S. Department of Agriculture.—Dept. Bull. 1270:—The Production of Narcissus Bulbs. (31 pp. + ix pl.) Washington, 1924. [63.52.]

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Department of Scientific and Industrial Research. Food Investigation Board.—Special Report No. 20:—The Problems of Apple Transport

Overseas: A General Survey and Summary of the Results Obtained by a Scientific Expedition to Australia in 1923, *F. Kidd* and *C. West*. (16 pp.) London: H.M. Stationery Office, 1924, 9d. net. [63.21; 63.41-198.]

Pests and Plant Diseases.

Hovell, M.—Rats and How to Destroy Them. (xlii + 465 pp.) London: John Bale, Sons & Danielsson, 1924, 10s. 6d. net. [63.269.]

Maryland Agricultural Experiment Station.—Bull. 264:—Control of the European Red Mite (*Paratetranychus pilosus*, Can. and Franz). (pp. 181-238.) College Park, Md., 1924. [63.27.]

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Ohio Agricultural Experiment Station.—Bull. 374:—Potato Diseases. (30 pp.) Wooster, 1924. [63.23-33; 63.24-33.]

Nebraska Agricultural Experiment Station.—Research Bull. 27:—Potato Wilt and Stem-End Rot caused by *Fusarium eumartii*. (83 pp. + 9 pl.) Lincoln, 1924. [63.24.]

Live Stock and Meat.

West Sussex County Council.—Report on Pig Feeding Trials with Dry and Soaked Meals at Kingsham Farm, 1923. (4 pp.) Chichester, 1924. [63.64: 043.]

Douglas, W., & Sons, Ltd.—Douglas's Encyclopædia: The Standard Book of Reference for the Meat, Pork, Provision, and General Food Trades. Third Edition. (309 pp.) Putney, London: W. Douglas & Sons, Ltd., 1924, 10s. [63.75; 664.9.]

Nicholls, G. J.—Bacon and Hams. Second Edition (Revised). (106 pp. + 31 pl.) London: Institute of Certified Grocers, 1924, 5s. [664.91.]

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Dairying.

The Disposal of Dairy Wastes, *L. C. Burroughs*. (Jour. Dairy Sci., vol. vii, No. 5, Sept., 1924, pp. 503-523.) [628.2.]

"Fruitiness" in Whey, *E. R. Hiscox* and *K. Lomax*. (Ann. App. Biol., vol. xi, Nos. 3 and 4, Oct., 1924, pp. 503-513.) [576.8: 7; 63.735.]

The Influence of the Administration of Certain Oils on the Nutritive Value of the Butter Fat of Cows on Winter Rations, *J. C. Drummond* and *Others*. (Jour. Agr. Sci., vol. xiv, No. 4, Oct., 1924, pp. 531-547.) [63.711.]

Veterinary Science.

Louping Ill, *Sir Stewart Stockman*;
Grass Sickness in Horses, *J. F. Tocher*;
Navel Ill or Joint Ill in Foals, with special reference to its predisposing causes, *J. R. M'Call*.
(Trans. Highland and Agr. Soc. Scotland, vol. xxxvi (1924), pp. 1-24; 65-83; 84-99.) [619.3; 619.1.]

Poultry.

The Nutritive Requirements of Poultry: The Effects of Adding Vitamin-Rich Substances to Normal Rations for Poultry. I.—The Fat Soluble Vitamin or Vitamin A (supplied by Cod Liver Oil), *J. B. Orr* and *H. Maciver*. (Scot. Jour. Agr., vol. vii, No. 3, July, 1924, pp. 266-277.) [63.651: 043.]

Dried Yeast Product as a Supplement to a Good Poultry Laying Ration as a means of Increasing Egg Production, *A. J. Souba*, *H. C. Knandel* and *R. A. Dutcher* (Poultry Science, vol. iii, No. 6, Aug.-Sept., 1924, pp. 204-213.) [63.651: 043.]

Mashless Rations, *J. H. Martin*. (Poultry Science, vol. iv, No. 1, Oct.-Nov., 1924, pp. 26-32.) [63.651: 043.]

The Scientific Principles of Artificial Incubation, *L. B. Atkinson*. (Jour. Roy. Soc. Arts, vol. lxxiii, No. 3,758, Nov. 28, pp. 37-55; No. 3,759, Dec. 5, 1924, pp. 62-82.) [63.65: 041.]

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NOTES FOR THE MONTH.

Agricultural Production in 1924.

THE Ministry's annual report on the agricultural production of England and Wales in 1924 is now in the press and will be published in the course of a few days.

The Report contains the final estimates of the production of the principal crops and of early potatoes, potatoes grown on allotments, mustard seed, rye, onions, carrots and sugar beet. Estimates of the production of each kind of small fruit and orchard fruit are also included, together with estimates of the production of meat, milk, butter, cheese, poultry, eggs and wool.

A review of the changes in the total production of the principal crops over the past 40 years is given in the Report, and also a comparison of the yields per acre in England and Wales and in the predominantly arable districts in the last 20 years as compared with 1885-1904.

Tables showing the estimated yields per acre of each principal crop in 1924 and 1923 as compared with the average of the ten years 1914 to 1923 in each county are appended, together with summaries of the production and yield per acre of the principal crops in Great Britain in each of the last eleven years.

The Report, which forms Part II of the Agricultural Statistics for 1924, will be obtainable at His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C.2, price 1s. 1d. post free, or it may be purchased through any bookseller, price 1s.

(59801) P.6./R.4. 8,250. 3/25 M. & S. A

Rural Workers' Scholarships.

THE Ministry of Agriculture and Fisheries announces that under the Scheme for establishing Scholarships and Maintenance Grants for the sons and daughters of agricultural and rural workers, a number of scholarships at University Departments of Agriculture, Agricultural Colleges, and Farm Institutes, are offered for award this year. The scholarships are confined to the sons and daughters of agricultural workmen and of other countryside workers in comparable financial circumstances. The awards cover all expenditure (tuition, board, outfit, travelling, etc.), and do not involve any outlay on the part of the parents.

Provided a sufficient number of suitable applicants is forthcoming, 10 Class I scholarships tenable for degree courses in agriculture or horticulture at Oxford, Cambridge, or other Universities, and in the case of veterinary science at the Royal Veterinary College; 10 Class II scholarships tenable for two years at Agricultural Colleges for one or other of the diplomas in agriculture, dairying, horticulture, or poultry-keeping; and about 150 Class III scholarships tenable for short courses in the same subjects at County Farm Institutes, will be awarded this year. In the case of Class I, preference will be given to candidates who have passed an examination which entitles them to enter a University. Forms of application and full particulars may be obtained from the Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, or locally from the offices of County Councils. The last date for submitting applications is 30th April, 1925.

This is the fourth year of the Scheme, which was approved in 1922 as an experimental measure for five years. Up to the present, 350 scholarships have been awarded, of which 103 were gained by young men and women who were wage-earners in the agricultural industry, 80 by sons and daughters of agricultural workmen, and 80 by sons and daughters of small holders. The parents of the remaining 87 are of varying countryside occupations, *e.g.*, bailiffs, gardeners, wheelwrights, saddlers, roadmen, etc.

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Farm Drainage.

UNDER the Lands Improvement Acts, an owner can obtain a loan of the entire sum required for farm drainage work, repayment to be spread over 25 years. During the 77 years in which this kind of facility has existed, landowners have borrowed no less than £9,000,000,

though the greater part of the sum was used within the first 10 years or so of the existence of the facilities.

The Ministry has no public funds at its disposal from which advances can be made to landowners for carrying out improvements under these Acts, but the Lands Improvement Company, of 1, Great George Street, Westminster S.W.1, is authorised by special Acts to advance money for the purpose.

Upon a landowner applying to the Ministry, through the Lands Improvement Company, for a charge under these Acts, the Ministry causes the land proposed to be improved to be inspected by an Inspector, upon whose report, if satisfactory, it sanctions the proposed improvement by a Provisional Order, and until such Order has been issued, the works should not be commenced. When the works have been completed and passed by the Inspector, the Ministry issues its Absolute Order, charging the lands improved with the cost of the works and any reasonable expenses incidental to the application, the amount of the charge being repayable by equal half-yearly instalments of principal and interest extending over the period for which the charge is sanctioned. In the case of field drainage, the maximum period is 25 years.

The interest charged by the Lands Improvement Company on its advances to landowners is subject to the approval of the Ministry; at the present time the rate is such as to yield to the Company a *net* return of 5 per cent. per annum.

As an illustration of the working of the procedure, it may be stated that for field drainage to be carried out at a cost of £200 to the landowner, the fees and charges of the Lands Improvement Company will amount to £17, and the fees of the Ministry to £7. The whole of this expense of £224 can be made the subject of a charge upon the lands improved, and the payment of the Lands Improvement Company for interest and sinking fund for 25 years would at present be at the rate of £15 15s. 10d. per annum.

The facilities available for landowners to carry out field drainage under the provisions of these Acts do not appear to be so widely known as is desirable. Out of a total sum of £123,039 charged upon lands by Absolute Orders of the Ministry in 1924, only £854 was in respect of improvements by field drainage.

It is also possible for a group of landowners or occupiers to combine for drainage work, and to form societies under the Agricultural Credits Act, 1923, in the same way as farmers

can now form societies to buy lime. Articles on the Agricultural Credits Act, 1923, and the conditions under which loans will be made are printed at pp. 401 and 480 of this *Journal* for August, 1924, and one on " Loans for the Purchase of Lime " was published in this *Journal* for November, 1924, p. 710.

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Diseases of Animals Report, 1923.

THE Annual Report of Sir Stewart Stockman, Chief Veterinary Officer of the Ministry of Agriculture, for the year 1923, is now available. The delay in its issue has been due to the fact that it was considered desirable to embody in this Report an uninterrupted record of the outbreaks of foot-and-mouth disease, not only during the year 1923, but up to the 31st May, 1924, when a short interval occurred in which no outbreak of the disease existed in any part of the country. As the series of outbreaks from August, 1923, to May, 1924, which reached a total of 3,096, was the most serious epidemic of the kind for 40 years, the record of the outbreaks and the methods used in combating them described in the Report assume a special interest and importance. The cost to the Exchequer in compensation for slaughtered animals during that period amounted to nearly £3,350,000.

The remainder of the Report refers to the calendar year 1923 only. It shows that there were no cases of Rabies in the country, that there were 9 outbreaks of Glanders, and that the number of cases of Parasitic Mange was reduced from 1,036 in 1922 to 796 in 1923. The extent of the prevalence of Sheep Scab remained practically stationary, whilst that of Anthrax and Swine Fever increased.

The second part of the Report is occupied by matters relating to the importation and exportation of animals, and the protection of animals from unnecessary suffering during their transit by land and sea. It contains a record of the steps taken to put into operation the provisions of the Importation of Animals Act, 1922 (Session 2), particularly with regard to the importation of Canadian Store Cattle. Reference is also made to the question of the importation of foreign hay and straw. The Report contains special articles dealing with the present position of the question of the exportation of horses to the Continent, the outbreaks of foot-and-mouth disease in the Channel Islands, and of Cattle Plague in Western Australia.

The Report concludes with a description of the work done at the Cattle Testing Station, Pirbright, and at the Ministry's Veterinary Laboratory, New Haw, Weybridge. The usual annual statistics of animal diseases and of animals exported and imported are contained in the appendices.

Copies of the Report can be obtained, either directly or through any bookseller, from H.M. Stationery Office, at the following addresses: Adastral House, Kingsway, London, W.C.2; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; and 120 George Street, Edinburgh. The price is 2s. 6d. net.

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Immunity Trials of Potatoes, 1924.

THE trials which are conducted by the Ministry each year with the object of testing new varieties of potatoes as to their immunity from Wart Disease were again carried out in 1924 on the farm of the National Institute of Agricultural Botany at Ormskirk, Lancashire. The actual field operations and the taking of records were carried out by Mr. Harold Bryan, B.Sc., and Miss Whitehead, of the Institute, but the trials were conducted on a plan approved by the Ministry.

The results of the trials have been considered by a small Committee composed of representatives of the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland, and co-ordinated with the results of the trials carried out at the testing stations of the two last-named Departments at Philpstown and Kilkeel.

The findings of the Potato Synonym Committee of the National Institute of Agricultural Botany have been accepted where recommendations as to the classification of varieties as synonymous with existing varieties have been made by that Committee.

After full consideration of the results of the 1924 trials, 16 new varieties have been added to the list of those approved as immune from Wart Disease. Descriptions of these varieties are given at p. 1170 of this *Journal*. In addition to those included in this list, 39 varieties successfully passed the test; the growers, however, do not propose to place these varieties on the market at the present time, and their inclusion in the approved list is accordingly postponed with the object of restricting the list to those varieties which have actually been or will be introduced into commerce.

Farm Workers' Wages.

ON page 1174 will be found particulars of the minimum rates of wages which have been fixed for adult male agricultural workers since the summary in the *Journal* for February, 1925, p. 1076, was compiled. The present list covers the areas of 29 Agricultural Wages Committees, and these, together with the particulars for 12 areas already published (viz., Bedford and Huntingdon, Berkshire, Cambs and Ely, Cumberland and Westmorland, Dorset, Essex, Hereford, Middlesex, Norfolk, Suffolk, Worcester and Anglesey and Carnarvon) make a total of 41 areas for which minimum wages have been fixed. The six areas for which no Orders have yet been made are Cornwall, Devon, Monmouth, Northumberland, Carmarthen and Glamorgan, and in each of these cases the Agricultural Wages Committee concerned has come to a decision as to the rates it proposes to fix and has issued the necessary notice.

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The Agricultural Index Number.

AVERAGE prices for agricultural produce generally advanced in January, and the average increase over the corresponding month in the years 1911-13 is now 70 per cent., as compared with 63 per cent. in December. The index figure for all commodities now stands at a higher level than in any month since July, 1922, when it was 72 per cent. above pre-war prices, and is 9 points higher than at this time last year.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	—
March ...	189	150	77	59	57	—
April ...	202	149	70	54	53	—
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat advanced sharply from 12s. 3d. per cwt. in December to 12s. 11d., the highest price recorded since May, 1922, and was 76 per cent. dearer than in January of the years 1911-13, as compared with 67 per cent. above in December. Oats were also dearer, and averaged 10s. per cwt. as against 9s. 7d. in December last, and the index figure records an advance of 9 points. Barley was unchanged in value on the month, but owing to a decline in price in the corresponding months of the basic years, the index figure has advanced from 76 to 81 per cent. above pre-war. All cereals were considerably dearer than in January, 1924, especially wheat and barley, the index numbers of which are 42 and 47 points respectively higher than a year ago, but oats only showed an increase of 8 points.

All descriptions of fat stock advanced in price, and fat cattle rose from 44 to 52 per cent. above pre-war prices, while sheep advanced from 84 to 107 per cent., and pigs, which usually decline in value at this time of the year, from 49 to 59 per cent. above 1911-13. Fat sheep and pigs were dearer than in January last year, but fat cattle were cheaper. Dairy cows declined in value by about £1 10s. per head, and owing to the fall in price being relatively greater than usual in January, the index figure shows a drop of 2 points on the month. Store cattle were unchanged in value, but as prices usually record a decline at this period of the year, the percentage increase has risen from 37 to 43 per cent. above 1911-13 prices. Store pigs and store sheep were both dearer, and the former have advanced 11 points and the latter 17 points since December. Dairy cows, store cattle and sheep were dearer than in January, 1924, but store pigs were somewhat cheaper.

Potatoes were slightly dearer, but the advance was not so rapid as is customary at the beginning of the year, and the index figure fell from 166 to 152 per cent. above the price in the basic years. Other vegetables were also dearer than in December and averaged 81 per cent. above 1911-13 prices, as compared with 41 per cent. above in the previous month. Cauliflowers were relatively the dearest, and were 171 per cent. above pre-war values, while celery was also very dear at 109 per cent. higher than in 1911-13. Brussels sprouts, cabbage and onions were 51, 60 and 65 per cent. respectively dearer than in the basic years. Carrots were comparatively cheap at only 28 per cent. above pre-war prices.

All descriptions of dairy produce, except milk, were cheaper than in December. Milk was unchanged in price, and the

index figure remains unaltered at 84 per cent. above pre-war. Butter realised practically the same price as in December, and the percentage increase remains unaltered at 73 above 1911-13, but cheese records a decline of 2 points. Following the sharp drop in December, the fall in egg values was not so rapid as in the basic years, and in consequence the index figure has advanced 31 points on the month.

Hay continues to sell at about the pre-war price, and is easily the cheapest of all agricultural commodities.

Index numbers of different commodities during recent months and in January, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.				1925.
Commodity.	Jan.	Jan.	Oct.	Nov.	Dec.	Jan.
Wheat ...	33	34	69	68	67	76
Barley ...	20	34	103	89	76	81
Oats	43	38	47	45	37	46
Fat cattle ...	61	56	48	47	44	52
Fat sheep ...	103	87	93	90	84	107
Fat pigs ...	102	43	40	45	49	59
Dairy cows ...	74	51	62	60	55	53
Store cattle ...	36	35	41	36	37	43
Store sheep ...	105	91	112	94	85	102
Store pigs ...	171	63	29	33	38	49
Eggs... ...	86	85	89	84	51	82
Poultry ...	81	60	67	58	64	63
Milk	90	87	81	82	84	84
Butter ...	73	68	73	74	73	73
Cheese ...	85	76	39	38	51	49
Potatoes ...	—1*	129	154	168	166	152
Hay	43	—1*	-3*	1	2	1

* Decrease.

MAIZE AND BARLEY FOR PIG FEEDING.

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Animal Nutrition Research Institute, Cambridge University.

THE investigations in pig feeding described in the following article deal with (*a*) the relative nutritive values of raw maize (soaked and unsoaked), cooked maize and flaked maize, and (*b*) the effect of grinding and cooking on the nutritive value of barley. The work was carried out on lines approved by the Research Committee of the Royal Agricultural Society of England and financed to a large extent by a grant from their funds.

The pig-feeder who cooks maize before feeding it to his animals does so in the belief that the process of cooking enhances the digestibility and feeding value of the maize to an appreciable extent. He naturally anticipates that the expense and trouble of cooking will be more than compensated for by the superior rate of gain of live weight shown by his animals as compared with that obtained when the maize is fed in the raw condition. This being so, it is of the utmost concern to practical feeders that the question of the influence of cooking on the digestibility of maize meal should be submitted to rigorous investigation.

A perusal of relative literature on the subject of the value of cooking foodstuffs in general leaves the reader uncertain as to the truth. Little experimental evidence is to be found to warrant outright the belief that cooking exerts any significant beneficial effect on feeding value, and the necessity for further investigations is very apparent. Indeed, certain writers state that cooking may actually result in a feeding-stuff becoming less digestible, this applying with special force to the important albuminoid constituent. The latter is coagulated as a result of the high temperature of cooking, and in this condition is less easily brought into solution by the action of ferments in the digestive tract.

Nor is the question limited solely to considerations of digestibility changes. Other aspects of the matter must receive attention when deciding whether a particular feeding-stuff should be fed in the dry, soaked or cooked condition. There is, for instance, little point in seeking to increase digestibility by cooking, if this results in the animal being unable to consume a ration equal in amount to that which it could eat if the foodstuff were

dry-fed. Again. it is also necessary to secure information as to the difficulty experienced by the animal in consuming the feeding-stuff in the dry, soaked and cooked conditions respectively, and to gain some idea of the amount of waste, not only of the foodstuff but also of energy, which may result as a consequence. This last consideration is naturally of special significance in regard to dry-feeding.

In order to be in a position to offer definite and useful advice to feeders on the question of cooking the maize ration of pigs, the Research Institute at Cambridge has submitted the matter to tests in an investigation stretching over a period of about two years. It is proposed in this article to give a summary of the results which have been obtained and to point out their significance in practical feeding.

The account of the investigation divides itself naturally into two sections. In the first section, the results of the determination of the digestibility of maize when fed to pigs in the unsoaked, soaked and cooked states will be summarised and discussed, and these results will further be compared with data obtained in a comparable manner expressing the digestibility of the commercial cooked maize commonly sold under the name of flaked maize. In the second section the results of large-scale feeding experiments carried out under farm conditions with dry, soaked and cooked maize will be given, these trials having been made in order to ascertain first, the amount of food consumption under the differing conditions of feeding when the animals were allowed access to all the food they could eat; secondly, the weights of dry maize, soaked maize and cooked maize required to produce 1 lb. of live weight increase. In addition, the results of a similar trial with barley will be brought forward in the second section.

The digestion experiments were carried out under the supervision of the writer, whilst the farm trials were directed by Professor T. B. Wood, F.R.S., with the assistance of Mr. N. Howard, B.A., in the initial stages and of Mr. H. G. Bevis, B.A., during the latter part of the investigation.

I.—RESULTS OF DIGESTION TRIALS.—It is not the intention of the writer to deal in this article with the technicalities involved in the carrying out of digestion trials with pigs.* It should, however, be mentioned that two Large White hogs were used for the purpose of the trials, weighing at the

* See a paper by the writer in the *Jour. Agri. Sci.*, January, 1925.

commencement of the experiment 11 st. 9 lb. and 11 st. 12 lb. respectively. The results for the two animals displayed excellent agreement throughout, this harmony being much more pronounced than that usually obtained in similar investigations with sheep. The results given in this article express the averages foı the two animals. The latter appeared not to mind confinement in the metabolism crates during the experimental periods of 15 days, and indeed did not suffer in any way as a result of their experiences. In the intervals between successive periods, they were restored to freedom and given a liberal ration composed of barley meal, middlings, bean meal and fresh green fodder.

In order to obviate possible difficulties arising from constipation, the maize rations were mixed with a definite weight of a coarse grade of middlings for feeding to the pigs. The digestibility of the middlings was determined in a separate experiment carried out with the same pigs, and it was therefore possible to make allowance for its presence in the experimental rations when calculating the digestion coefficients of the maize. Table I gives a statement of the rations fed in the several periods of the trial.

TABLE I.—SCHEME OF DAILY RATIONS.

Period 1.		*Period* 2.	
Flaked maize ...	1,000 grammes (2 lb. 3¼ oz.)	Crushed maize ... (soaked)	1,200 grammes (2 lb. 10⅓ oz.)
Coarse middlings ...	500 grammes (1 lb. 1⅝ oz.)	Coarse middlings...	500 grammes (1 lb. 1⅝ oz.)
Period 3.		*Period* 4.	
Fine maize meal ... (cooked)	1,400 grammes (3 lb. 1⅓ oz.)	Crushed maize ... (unsoaked)	1,500 grammes (3 lb. 4⅞ oz.)
Coarse middlings ...	500 grammes (1 lb. 1⅝ oz.)	Coarse middlings...	500 grammes (1 lb. 1⅝ oz.)

It will be noted that the rations were not designed to secure big gains of live weight during the experimental periods. In the intervals between periods, however, when the pigs received the ration of barley meal, middlings, bean meal and green fodder, rapid increase of weight was noted, and it was therefore essential to increase more or less regularly the allowance of maize in the successive periods to meet the requirements of the growing animals. The amount of middlings, on the other hand, remained constant throughout the trial.

Preliminary Treatment of Rations.—The following notes on the preliminary treatment of the rations are of importance:—

Period 1.—The mixture of flaked maize and middlings for the day's feeding was allowed to soak and swell overnight in $4\frac{1}{2}$ litres ($7\frac{9}{10}$ pints) of cold water.

Period 2.—The mixture was soaked overnight in 3 litres ($5\frac{3}{10}$ pints) of cold water.

Period 3.—To the 1,400 grammes (3 lb. $1\frac{1}{3}$ oz.) of fine maize meal was added $4\frac{1}{2}$ litres ($7\frac{9}{10}$ pints) of water in an enamel bucket. After thorough mixing, the bucket with its contents was placed in a large vessel containing water boiling vigorously. The bucket was then fitted with a lid and the cooking of the maize meal continued for three hours, the material being frequently stirred with a large wooden spoon. During this time the meal had swollen to a pasty mass which was "velvety" to the touch. After cooling in running water, the middlings, together with a further litre ($1\frac{3}{4}$ pints) of water, was well stirred in, and the mixture was allowed to stand overnight before being fed to the pigs.

Period 4.—The middlings part of the ration was soaked overnight so as to ensure comparable feeding of this part of the ration in all the periods. The maize was slightly moistened with water in the trough at the time of feeding, this being necessary to prevent scattering and wastage of the food. During this period, however, the maize may be regarded as having been fed in the unsoaked condition.

Remarks on Feeding.—During the whole of the time occupied by the pigs in feeding, two assistants were in attendance to ensure complete consumption of the ration, returning carefully to the trough any of the material which was spilt during the process. The food was given in two and sometimes three portions during the day as seemed desirable, the last traces of material being swilled from the buckets into the troughs by means of small portions of water. The animals were given frequent access to drinking water.

Period 1.—The flaked maize ration was consumed eagerly and without waste.

Period 2.—The ration containing the crushed maize did not swell during soaking to anything like the same extent as did the flaked maize ration and consequently less water was needed for the purpose. No difficulty was encountered in securing complete consumption.

Period 3.—The cooked maize meal ration was eaten eagerly and without waste. In this, as in the preceding periods, little water was required by the pigs beyond that contained in the ration.

Period 4.—The feeding during this period was attended with difficulties, the animals experiencing considerable trouble in masticating and swallowing the unsoaked maize. They consumed the food slowly and frequently raised their heads from the troughs in their efforts to overcome mastication difficulties. This naturally led to the food being scattered somewhat, and much time and labour were expended on the part of the attendants with a view to securing complete and clean consumption. The slowness with which the pigs took their meals, and the indifferent appetites displayed, made it necessary to offer the food in three and sometimes four portions during the day, and although the patience shown by the attendants led to the ration

being consumed without measurable waste, yet it must be stated that the experience of this period warranted the conclusion that it would be inadvisable under ordinary conditions to attempt the feeding of unsoaked crushed maize to swine.

TABLE II.—SUMMARY OF DIGESTION COEFFICIENTS.*

	Unsoaked Maize. per cent.	*Soaked Maize. per cent.*	*Cooked Maize Meal. per cent.*	*Soaked Flaked Maize. per cent.*
Dry Matter	85.9	86.9	88.1	95.2
Organic Matter	87.1	87.8	89.0	95.4
Protein	78.4	80.1	86.1	95.5
Oil	63.5	60.5	63.6	44.8
Carbohydrate	91.5	92.0	92.4	97.1
Fibre	23.1	35.3	22.6	30.5

Discussion of Results of Digestion Trials.—The figures given in Table II bring out clearly the effect of preliminary treatment on the digestibility of maize. Ignoring for the moment the soaked flaked maize, reference to the dry matter and organic matter digestion coefficients shows that the digestibility is highest for cooked maize meal and lowest for unsoaked maize. These findings are in accordance with common anticipation; the surprising feature of the results, however, lies in the discovery of the small extent to which maize digestibility is increased by soaking or cooking. The effect of thorough soaking is merely to raise the digestion coefficient of the maize dry matter from 85.9 to 86.9 per cent. and very efficient cooking only brings about a rise to 88.1 per cent., in spite of the fact that the conditions of the trial were weighted in favour of the cooked maize by the use of fine meal for cooking and crushed maize for dry-feeding.

A low degree of digestibility might justifiably have been anticipated for the unsoaked maize, since the hard flinty nature of the grain, even after crushing, might render it liable to pass through the digestive tract into the dung in appreciable amount without having been much affected by the digestive ferments. It is not uncommon to note the presence of small pieces of apparently unattacked maize in the dung from animals receiving unsoaked maize. That this factor may not possess any great significance, however, is revealed by the results of the present trial, and it must be concluded that swine possess the capacity

* The results of digestion trials are usually given in this form. The digestion coefficient expresses the number of parts of a particular constituent of a foodstuff which are digested by the animal per 100 parts of that constituent consumed in the ration. Thus, the digestion coefficient for the dry matter of the unsoaked maize meal signifies that for every 100 grammes of dry matter consumed, the animal is able to digest and utilise 85.9 parts. In other words, the dry matter is 85.9 per cent. digestible.

to digest unsoaked crushed maize to an extent almost equal to that with which they are able to digest it after softening by soaking. The writer does not, however, regard these results as an argument for the feeding of dry maize to pigs. The following considerations must be set against the results obtained in the digestion trials :—

(1) The difficulty of masticating the dry crushed maize may lead to wasteful consumption under ordinary farm conditions.

(2) The hard flinty nature of the grain may be productive of sore mouths.

(3) The value of maize meal in producing live-weight increase is not conditioned solely by considerations of digestibility. If a foodstuff is not easy to masticate and digest, then the animal may expend considerable energy in these processes. This wastage of energy by the animal naturally leads to a corresponding diminution in the productive energy of the feeding stuff. In simpler language, the animal is not able to make the fullest possible use of its food and the maximum rate of gain of live-weight is therefore not possible.

For the reasons cited above, it is clearly advisable to soak maize thoroughly before feeding to swine. With meals of a softer nature, however, the arguments against dry-feeding might not be so weighty.

In regard to the effect of cooking, it is evident that although this treatment enhances the digestibility of the maize meal, yet the gain is not sufficient to warrant the expense and trouble of cooking *on the farm.* From the point of view of digestibility, the pig-feeder is recommended to feed raw maize in the soaked condition. Other aspects of this question will be discussed in a later section of the article.

Carbohydrates.—The results obtained for the digestion coefficient of the carbohydrate constituent in the different maize rations are of special interest, since starch is the most important ingredient of the maize grain from the nutrition standpoint. In this connection, two opposing views have been held formerly :—

(1) The adherents of the dry-feeding system maintain that since food fed in the dry condition requires very thorough mastication before it can be swallowed, this must lead to a more intimate admixture with saliva and consequently to a more efficient digestion of the starch constituent. This argument is somewhat superficial, however, since digestion of starch is by no means conditioned solely by the activity of the ptyalin of the saliva, the main action probably occurring when the softened and semi-digested food mass encounters the amyloptic ferment of the pancreatic secretion. Moreover, the evidence of this investigation lends no support to the dry-feeding hypothesis, since the digestion coefficient for the starch was slightly lower in the case of unsoaked maize than that for the starch in the soaked maize.

(2) The view is also held that since cooking leads to the bursting of the cellulose coatings of the starch cells and the liberation of the starch in a

swollen, pasty condition, it follows that such treatment should facilitate digestion of the starchy constituent. The results of the present experiment showed only a minor increase of the digestion coefficient of the starch as a result of cooking. Soaking raised the coefficient from 91.5 to 92 per cent., whilst cooking brought about a further slight increase to 92.4 per cent. These values are all of the same order, and it must be concluded (*a*) that the cellulose coatings of the starch cells are easily removed or dissolved during digestion, and (*b*) that although cooking may render the starch more *easy* of digestion, yet, when dealing with animals possessing extensive digestive tracts, this does not necessarily imply a more *complete* digestion of the constituent in question.

Protein.—Attention should be directed to the interesting results obtained in connection with the digestibility of maize protein. As was pointed out in the introduction to this article, the usual view is that cooking depresses protein digestibility, this resulting from coagulation of protein at the temperature of cooking. The writer has already pointed out elsewhere that this view rests on insecure experimental evidence, and that the ease or difficulty of digestion of any particular food constituent does not necessarily determine the extent to which the ingredient will be digested by animals possessing large digestive tracts. A study of the results given in Table II shows that cooking led to a very definite increase in the digestion coefficient of the maize protein, the value increasing from 78.4 per cent. in the unsoaked maize to 86.1 per cent. in the cooked maize meal. The effect was even more marked in the case of flaked maize and is probably to be attributed to the circumstance that cooking may lead to the removal of material which to some extent protects the protein against digestion in the alimentary canal. Cooking therefore may render the protein more accessible to the action of the digestive ferments, and as a consequence digestion of protein proceeds to a greater extent.

Fibre.—The digestibility of maize fibre was highest in the soaked maize period (35 per cent.) and fell to about 23 per cent. in the periods when unsoaked and cooked maize were tested. This result possesses little significance in connection with the question at issue, since apart from the uncertainty attaching to measurements of fibre digestibility with swine, it is possible that the depression arose partly as a consequence of increasing progressively the bulk of the maize ration in the successive periods of the experiment. That maize fibre digestibility may vary considerably in differing maize rations is shown by the results of a separate trial, where the maize was fed along with milk instead of middlings. Here the value of the fibre digestion coefficient rose to about 51 per cent.

Oil.—The digestion coefficients for the oily constituent of maize ranged from about 60 to 64 per cent. in the three periods, this agreement, when the peculiar difficulties attendant on determinations of oil digestibility are taken into account, being sufficiently close to warrant the conclusion that soaking and cooking are without effect on the digestibility of maize oil.

Nutritive Value of Flaked Maize.—Considerable interest attaches to the determination of the digestibility of flaked maize in view of the efforts of certain commercial enterprises to popularise this form of maize with the stock-feeder. The latter is naturally desirous, in view of the higher cost of flaked maize compared with raw maize, of securing information in regard to the relative nutritive values of these two commodities.

A slight sketch of the method of production of flaked maize will give some clue to the nature of this feeding-stuff. The initial process consists in screening the grain, when by means of ingenious devices small pieces of metal, string, cobs and other undesirable ingredients are removed. The grain is then submitted to softening in a preliminary cooker and from there passes to the main cookers. Here the softened grain, during its slow passage through the cooker, is thoroughly cooked by the action of steam, the process being so conducted as to ensure cooking throughout the whole grain. The process is a continuous one, and the underlying principle appears to be gradual rather than sudden cooking. After passage through the main cooker, the material again encounters the action of steam and then moves along to the hot rollers which transform it into thin flakes. In the final process the flaked, but still damp material, is freely shaken to liberate steam and then passes to the drying appliances, where treatment with hot air ensures a sufficiently low moisture content to permit of storage without risk of decomposition. The resulting material is an attractive product of a light. bulky nature, consisting of thin, crisp yellow flakes. Table III gives a comparison of the composition of raw and flaked maize.

TABLE III.—COMPOSITION OF RAW MAIZE AND FLAKED MAIZE.
(Calculated to dry matter basis).

	Raw Maize. per cent.	*Flaked Maize. per cent.*
Protein	10.95	11.71
Oil	5.12	2.16
Carbohydrates	79.80	84.47
Fibre	2.27	0.71
Ash	1.86	0.95

A study of the analytical data in Table III reveals the fact that during the production of flaked maize, a portion of the oil, fibre and mineral matter is lost. It must be pointed out, however, that the aim of the manufacturer is to include the whole of the grain in the flaked product, and that at no stage of the process is anything wilfully added to or taken from the material. The steaming is conducted in closed cookers under conditions which appear to preclude the possibility of the drainage away of liquid. The minor changes in composition are not in reality of any disadvantage to the buyer of flaked maize, since their resultant effect is to increase the percentage of starch and protein in the product. It is well known that maize shows a tendency to produce soft pork, and if, as seems probable, this is due to the effect of maize oil, then a reduction in the percentage of this constituent may well prove of advantage to pig-feeders.

Further chemical tests showed that the cooking process coagulates the small amount of soluble protein in the grain, but renders the starch soluble in cold water.

The results obtained in the flaked maize period of feeding (see Table II) point to the very high digestibility possessed by this feeding-stuff. The digestion coefficient of its dry matter reaches the high figure of 95.2 per cent., as compared with the figure 86.9 per cent. for the dry matter of soaked maize meal. This enhanced digestibility is to be attributed partly to the effects of cooking, partly to the fact that the starch and protein are present in a form easily accessible to digestive ferments (effect of reduction of fibre content and of rolling) and partly to the palatable character of the flaked maize.

That maize protein may reach a high degree of digestibility as a result of processes like cooking and rolling is shown by the value of the protein digestion coefficient of flaked maize, namely, 95.5 per cent. (as compared with 80 per cent. for the protein of soaked maize and 86 per cent. for that of maize cooked under "kitchen" conditions). The starch of flaked maize is almost wholly digested; its digestion coefficient was 97 per cent. as compared with values lying between 91.5 and 92.4 per cent. for the maize meals. The ready solubility in cold water leads in all probability to the easy and rapid digestion of this constituent. The fibre remaining in the flaked maize possesses the same order of digestibility as that of soaked maize, whereas the residual oily constituent is digested to a somewhat smaller extent than the oil of the raw grain.

In Table IV the amounts of digestible nutrients in raw and flaked maize have been summarised. In calculating the data for raw maize, the digestion coefficients for soaked maize meal have been employed.

TABLE IV.—DIGESTIBLE NUTRIENTS IN RAW MAIZE AND FLAKED MAIZE.
(Calculated to dry matter basis).

	Raw Maize. per cent.	Flaked Maize. per cent.
Organic matter ...	86.09	94.39
Protein	8.77	11.18
Oil	3.10	0.97
Carbohydrate ...	73.42	82.02
Fibre	0.80	0.22

The results given in Table IV show that flaked maize contains an exceptionally large percentage of digestible organic matter, composed almost entirely of highly digestible carbohydrate and protein. In assessing the production starch equivalents of raw and flaked maize as purchasable on the market, the following points should be kept in mind :—

(*a*) Flaked maize is a dryer commodity than raw maize. The average moisture content of the latter is round about 13 per cent., whereas that of flaked maize appears to vary between 10 and 12 per cent., with a mean value round about 11 per cent. The values in the present investigation were 11.17 per cent. for flaked maize and 13 per cent. for raw maize meal. It follows, therefore, that a ton of flaked maize contains actually more dry foodstuff than a ton of raw maize.

(*b*) It is justifiable to assume that the "percentage availability" (factor V) of flaked maize is somewhat greater than that of raw maize, since the percentage of indigestible material has been reduced to an extremely small value in the flaked product. Factor V for raw maize, however, is usually given the full value of 100, but in instituting a comparison between the two maize feeding stuffs, it is fairer to assume that for flaked maize factor V has the maximum value of 100, whilst for the raw grain the value is somewhat lower. Taking the availability of raw maize to be 99, a not unfavourable assumption for this foodstuff in relation to the flaked variety, then the following values for the production starch equivalents* can be computed :—

Production starch equivalent of 100 lb. flaked maize containing 11.17 per cent. moisture ... ... = 84.3

Production starch equivalent of 100 lb. raw maize containing 13.00 per cent. moisture ... ... = 76.7

It is thus evident that for purposes of production in pigs (fattening, etc.) 100 lb. of flaked maize has a value equal to that of 84.3 lb. of starch when the foodstuff is added to a main-

* In these calculations the usual conversion factors of Kellner have been made to apply to food for pigs. Since the main object, however, is to secure a comparison between the nutritive values of raw and flaked maize, the adoption of these factors is permissible for this purpose.

tenance ration, whereas 100 lb. of raw maize is equivalent to 76.7 lb. of starch, *i.e.*, a difference of roughly 8 per cent. in favour of the flaked maize. A further comparison is gained by calculating the "digestible food units" per ton according to the conventional method. On this basis the figure for flaked maize is 97.9 and that for raw maize 88.3, again a difference in favour of the flaked product of the order of 10 per cent.

These figures should serve as a guide in deciding the relative money values of raw and flaked maize from the strict standpoint of nutritive value. It should also be remembered that in purchasing flaked maize, the feeder avoids the expense and trouble of crushing or grinding.

The high worth of maize meal for fattening is well known, but the results of this investigation show that flaked maize is even superior in this respect. Like raw maize, however, it must be regarded as an unbalanced food, being especially deficient in regard to the important mineral constituents which are necessary for the proper development of the bones of animals. Due care should therefore be exercised, when making up rations containing flaked maize, to ensure that the deficiencies in respect of protein and ash are rectified by proper additions of other foodstuffs.

There can be no doubt, however, that if a feeder desires to include cooked maize in the rations for pigs, this can best be done in the form of flaked maize, provided the price be satisfactory. Apart from the advantages gained in regard to digestibility, the feeder avoids the trouble and expense of crushing and cooking on the small scale and the risk of losing appreciable quantities as a result of the wet material turning sour.

Flaked maize should be especially valuable for inclusion in the heavy rations designed for the purposes of (1) finishing off animals for the showyard, (2) keeping up the milk yield of heavy milking cows. In both these cases, the factor which may limit production is the capacity of the animal for consuming and digesting a sufficiency of food without incurring digestive troubles. Hence the value of a food like flaked maize, which supplies easily and almost wholly digestible nutrients in a concentrated form, and does not tax the animal by adding materially to the undigested food residues which have to be excreted.

II.—RESULTS OF LARGE SCALE FARM TRIALS.—With the object of further testing the effect of preliminary treatment of foodstuffs on their nutritive value, two investigations with swine were carried out at How Hill Farm, Cambridge,

In the first trial maize was the foodstuff selected for investigation, whilst in the second experiment home-grown barley was used.

Farm Trial with Dry, Soaked and Cooked Maize.—The trial was carried out on 80 young Large Black by Large White first cross pigs. These were divided into 8 even lots of 10 animals. In order to ensure a sufficiency of protein and ash in the diet, every animal received a basal ration containing $1\frac{1}{4}$ lb. of middlings and $\frac{1}{4}$ lb. of fish meal. Further, with a view to supplying the requisite growth factors, each animal was given a small allowance of green fodder daily throughout the experiment. The remainder of the ration consisted of maize, and all the pigs were given as much of this feeding-stuff as they would clean up. Table V shows the condition in which the maize was fed to the different lots.

The experiment had unfortunately to be discontinued at the end of six weeks, owing to some of the animals being attacked by swine erysipelas. The results for the six weeks' period are summarised in Table V. It should be mentioned that the individual pigs in the several lots made fairly uniform live-weight increases, and that for this reason the results may be regarded as reliable.

TABLE V.

Lots	Average weight of animals at beginning lb.	Total weight of food eaten lb.	Total live-weight gain lb.	Average gain per pig per day lb.	Weight of food eaten per lb. of live weight increase lb.	Maize (how fed)
1 5	45 28	1,707 1,337	453 397	1.08 0.95	3.77 3.37	Crushed and dry " " "
Average 1 and 5		1,522	425	1.01	3.57	
2 6	45 28	1,619 1,309	445 425	1.06 1.00	3.64 3.08	Crushed and soaked " " "
Average 2 and 6		1,464	435	1.03	3.36	
3 7	45 28	1,625 1,293	457 404	1.09 0.96	3.55 3.20	Ground and soaked " " "
Average 3 and 7		1,459	430	1.02	3.38	
4 8	45 28	1,423 1,167	421 393	1.00 0.94	3.38 3.00	Ground and cooked " " "
Average 4 and 8		1,295	407	0.97	3.19	

The figures given in Table V lead to several interesting conclusions :—

(1) Pigs, when allowed access to all the food they will eat, consume more food when fed dry than when the food is soaked. The reason for this lies no doubt in the fact that soaking swells the grain and makes it more filling.

(2) Cooking maize decreases still further the amount which the pigs will consume, again because the cooking, by further swelling the grain, makes it still more filling.

(3) The greater consumption of dry maize does not produce a proportionally greater live-weight increase, nor does the smaller consumption of cooked maize produce a proportionally smaller live-weight increase. All the pigs in the trial put on practically 1 lb. live-weight per head per day.

(4) It follows that soaking the maize decreases the amount of food required to produce 1 lb. of live-weight increase and cooking is still more effective in this direction. There appears to be no advantage in grinding the maize before soaking, the results for crushed soaked and ground soaked maize being very similar.

It will be seen that the above conclusions are substantially in harmony with those arrived at as a result of the digestion trials. 1 lb. live-weight increase is produced more economically by cooked maize than by dry maize, the saving of foodstuff being 0.38 lb. for each 1 lb. of live-weight increase. This would be anticipated by a consideration of the digestion data, since cooking not only brings about a definite, though not considerable, increase in the digestibility of maize, but also leads to a minimum wastage of energy by the animal in mastication. Further, cooked maize is consumed less wastefully than dry maize. The superiority of cooked maize over soaked maize is not so pronounced and is represented by a saving of 0.17 lb. of foodstuff per 1 lb. live-weight increase. Again, this finding is foreshadowed by the results of the digestion trials, since the digestibility of soaked maize lies midway between those for unsoaked maize and cooked maize. Against this slightly superior nutritive efficiency of cooked over soaked maize must be set the following considerations : (*a*) The expense of cooking; (*b*) the fact that only relatively small amounts of maize can be cooked at a time, for fear of the material turning sour if kept too long before feeding; and (*c*) the fact that the use of cooked maize does not make possible a superior rate of gain of live weight, since the animal is unable to consume as much foodstuff wher it has been cooked as when it has been soaked.

The conclusion is again justified that little is to be gained by cooking maize on the farm for pigs.

Farm Trial with Home-Grown Barley.—After the completion of the maize trial outlined above, it was decided to carry out a second and similar investigation with rations in which home-grown barley should be included instead of maize, in

order to secure information in regard to the effect of grinding, soaking and cooking on this feeding stuff.

For this purpose 50 uniform pigs were selected and divided into 5 equal lots of 10 animals. The different lots were all given the same basal ration as before, namely, $1\frac{1}{4}$ lb. middlings and $\frac{1}{4}$ lb. fish meal. Additional food was given up to the limits of appetite in the form of barley, which was fed to the several lots as is indicated in Table VI. All the animals received also a small amount of green food every day. The feeding trial extended over a period of eight weeks, and again the individual animals in each lot made satisfactorily uniform live-weight increases. The results are summarised in Table VI. It will be noted that Lot 5 of the pigs received cooked maize instead of barley, this making possible a comparison of the nutritive values of these feeding stuffs.

TABLE VI.

Lots	Average weight of animals at beginning	Total weight of food eaten	Total live-weigh gain	Average gain per pig per day	Weight of food eaten per 1 lb. of live-weight increase	Barley (how fed)
	lb.	lb.	lb.	lb.	lb.	
1	116	2.486	603	1.08	4.12	Whole, dry
2	116	2,502	593	1.06	4.22	Whole, soaked
3	116	2.584	695	1.24	3.71	Ground, soaked
4	116	2.533	669	1.19	3.79	Ground, cooked
5	116	2.415	705	1.26	3.42	Cooked maize

The figures in Table VI lead to the following conclusions :—

(1) In the case of these older and heavier pigs fed on barley, soaking grinding and cooking exert little or no effect on the amount of food consumed. This may be due either to the fact that barley does not swell on soaking or cooking to the same extent as maize does, or to the greater stomach capacity of the larger animals.

(2) Soaking alone fails to improve the nutritive value of whole barley.

(3) Grinding followed by soaking leads to a marked increase in the nutritive value of the barley.

(4) Cooking the barley does not enhance the nutritive value beyond that possessed by ground, soaked barley.

(5) Cooked maize is definitely higher in nutritive value than dry, soaked or cooked barley.

Main Conclusions.—It is manifestly not possible to re-state within the scope of a short summary all the conclusions of scientific and practical interest which have been arrived at in an investigation of this kind. We may therefore only endeavour to emphasise one or two points of special interest to the pig-feeder :—

(1) The pig-feeder is recommended to feed maize meal in the soaked and not in the cooked condition. The gain in nutritive value as a result of cooking is not sufficient to compensate for the labour and expense of cooking, and the risk of the wet material turning sour.

(2) The superiority of flaked maize over raw maize has been demonstrated, and an approximate idea of the relative money values of these commodities, based on nutritive value, has been given.

(3) Young pigs are able to consume larger amounts of maize-containing rations when the latter are fed dry than when they have been soaked. Cooking the maize still further decreases the amounts such pigs are able to consume. Arguments against dry feeding in the case of maize have been brought forward.

(4) Grinding of whole barley followed by soaking improves its nutritive value, but the latter is not further enhanced by substituting cooking for soaking.

(5) Cooked maize is definitely higher in nutritive value than dry, soaked or cooked barley.

In conclusion, the writer would like to thank Messrs. R. and W. Paul, Ltd., for granting him facilities for the inspection of the processes by which flaked maize is produced.

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THE COST OF WINTERING CATTLE FOR THE PRODUCTION OF FARM-YARD MANURE.

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FARMYARD manure occupies a high place in the estimation of most arable farmers in this country. There is no fertiliser which has been in use over so long a period, or which confers such a variety of benefits upon the soil and crops.

Scientific research has brought to light exceedingly interesting and valuable information respecting the composition and action of this manure. These investigations have, however, been concerned mainly with its effect upon the yield of crops, which is only one aspect of the farmer's principal concern—the realisation of maximum profit. It may be possible by certain treatment to secure larger crops, but whether it is sound policy to do so will depend upon the financial result. The question to be answered is whether the increase in value (either for sale or for further

production) will exceed or fall short of the cost of the treatment which produces it, plus the cost of handling the additional crop. In answering this question it is of course necessary to take one year with another and to consider the results of the farming enterprise as a whole as well as those of particular departments.

It is well known that other methods of soil amelioration, such as chalking and marling, which were almost as firmly established as dunging, fell into disuse during the latter part of last century owing mainly to rising costs and falling prices for produce. Although there is abundant evidence that much land would to-day greatly benefit by the application of chalk or marl (which is frequently to be got on the farm or near by) there is little sign of a revival of the practice. The economic conditions which caused its decline still obtain, while the availability of lime in more concentrated forms provides an alternative method of supplying to the soil this important constituent, and it is now possible by restricted choice of crops on a modified rotation, to farm land without that attention to liming which has sometimes been considered indispensable.

It may well be, similarly, that in some cases the system of making and applying farmyard manure is also uneconomic under present conditions. Here, however, the considerations involved are more complex and there are several factors which make it difficult to obtain a clear view of the problem and which tend to prevent the decline of the practice. Farmyard manure is a home product the cost of which is almost invariably unknown. It has always been the chief and most important fertiliser available and farmers are slow to appreciate that its benefits may in some cases be conferred by other means. This conservatism is shared by landlords and valuers, whose influence tends to perpetuate rules and customs which grew up before science had made the discoveries which have added so enormously to modern agricultural knowledge. Further, the production and application of dung is part and parcel of most of the established farming systems, and even those pioneers who experiment with methods and products usually stop short of interference with accepted systems. But dangerous disease calls for drastic treatment, and there are authorities who contend that enlightened revision of systems would do more to relieve agricultural depression than all the piecemeal remedies which have been promulgated.

In the course of his tours, some twelve to fourteen years ago, of many of the principal farming districts in the British Isles, Sir Daniel Hall was evidently impressed by the economic aspect of the dunging practice, for he refers to it several times in his

book " A Pilgrimage of British Farming." After describing a farming system which appeared to be giving good results on the Lincoln Heath, he writes (p. 96), " Moreover, it (the area under cultivation) received very little dung, the necessary fertility being brought in by the artificial manure for the peas and the roots, and the cake which is fed to the sheep on the temporary pastures. The land looked no better than, perhaps hardly as good as, the Norfolk land for which farmyard manure in quantity is regarded as the only possible means of securing proper crops throughout the rotation." Elsewhere, Sir Daniel found a farm where (p. 88) " Often the red clover was allowed to grow after the first cut, and the second growth was ploughed under, thus enriching the land as much as a coating of dung would have done." He also mentions (p. 135) a farmer who himself doubted the profitableness of wintering cattle in order to trample straw into dung. Notwithstanding the complexity of the subject its importance seems, therefore, to call for careful investigation.

Methods of Producing Dung.—Farmyard manure is produced in different ways according to the style of farming and lines of production followed. It may, for example, be made by working horses, dairy cows or young horned stock. In these cases the manure is usually a by-product of the process of producing horse labour, milk and cattle respectively. The farmer is concerned with the economic considerations affecting the principal products and if he decides to follow these lines of production the manure is necessarily obtained and must be disposed of to the best advantage.

There are, however, other cases where the manure itself may be properly described as the principal product. For example, in some districts there are arable farmers who take in cattle to winter gratis or for a nominal payment in order to get their straw trampled into the dung which is considered indispensable for the crops they grow. The manure is then the sole product of the process, and must therefore be charged with the full net cost. In many other cases it is the practice to purchase store cattle to winter for the same purpose, and, provided the object in view is the production of manure, the same principle applies. Cattle kept for this purpose should, in fact, be regarded as manure-making machines, the running cost of which (food, labour and incidental expenses) together with the cost of raw material (straw) should be charged to the product (manure).

When winter fattening is carried on the issue is not so well-defined, for we then have two products, manure and beef, either or both of which may be expected to yield a return for the cost

of wintering. In order to present the results of this practice in a simple form, it is usually desirable to consider either manure or beef as a by-product and to deduct its value from the gross cost of wintering in order to arrive at the net cost of the other, *i.e.*, the principal, product. The relative importance of the two products in the farm economy will depend upon the circumstances of each individual case, but there is no doubt that the majority of farmers who practise winter fattening attach a great deal of value to the manure obtained and look for a return from their crops for at any rate a large part of the cost of the process.

A Mixed Farm Case.—It is proposed to consider here a case in which manure is the principal product of wintering. Unfortunately, there are no general data from which conclusions can be drawn, but with a view to presenting the problem in concrete form it is proposed to quote figures extracted from the cost accounts of a mixed farm of some 4,000 acres situated in the south of England.* These figures are introduced merely by way of illustration and are not put forward as being capable of general application. Further, the method of treatment suggested applies only to those cases where expense is incurred in the maintenance of cattle primarily for the production of farmyard manure. It is not applicable to manure obtained as a by-product of other lines of production such as those mentioned above. Every case must, in fact, be considered separately, for differences in internal and external conditions may cause a system or practice which is uneconomic in some cases to be quite consistent with sound management in others. It is only by going to the trouble of obtaining reliable information concerning the economic side of his own business and comparing it with results obtained elsewhere, or with estimates of the outcome of possible alternatives, that the farmer can direct his enterprise to the best advantage. The knowledge so obtained must be used with caution, and due weight must be given to the available results of technical research. Sound farming policy cannot be determined by statistical methods alone; technology and economics are complementary, and it is only by an intelligent use of both that the best results can be obtained. This applies with particular force to a complicated question like that of farmyard manure, and this article is written in the hope of stimulating that economic investigation without which it is impossible to realise the full benefits of the labours of research

* The costs quoted in this paper were prepared privately and the methods differ in some respects from those adopted by the Committee on Agricultural Economics.

workers who are concerned principally with the physical and biological aspects of the problems involved.

Division of the Land.—On the above-mentioned farm the land is about equally divided between arable and grass, some chalk down being included in each category. The heavier arable (1,188 acres), which is practically all two-horse land, is cropped on a four-course rotation, farmyard manure being applied to about one-fourth of the area each year. Most of this manure is produced by cattle which are wintered in open yards, some being fattened and sold while the remainder are kept on a maintenance ration only and are turned out in spring to fatten on the grass. The yards are conveniently situated about the farm, and the cropping is arranged in four-course shifts around each yard in order to minimise carting of the crops and manure.

Number of Cattle and Food Used.—During the winter of 1922-23 the average number of such cattle on the farm was 196. The wintering period covered approximately 166 days, from about 1st December to about 15th May. The store cattle were fed on a maintenance ration consisting of hay, mangolds and stack silage, together with the straw which served for either food or litter. These were charged at cost of production. Owing to adverse climatic conditions some of the crops had yielded badly, and the unit costs were therefore high. For the present purpose it is advisable to eliminate this abnormal factor, and the costs have therefore been re-calculated on the basis of estimated normal yields. The actual and estimated costs are compared in Table 1. The fattening cattle received also barley and rye meal, which was charged at market value.

Table 1.–Actual and Estimated Cost of Home-grown Foods.

Crop, 1922.	Actual. Yield per acre.	Actual. Cost per ton.			Estimated.* Yield per acre.	Estimated.* Cost per ton.†		
	cwt.	£	s.	d.	cwt.	£	s.	d.
Meadow hay	14½	3	10	10	20	2	16	7
Pea and oat hay ...	15	11	11	5	60	3	5	6
Stack silage	36	3	12	0	120	1	7	0
Mangolds	338	1	6	0	600		15	6

The apportionment of the cost of a corn crop between the grain and the straw always presents difficulty. The method adopted in this case was that of charging the straw with all costs of harvesting (except the cost of the string), all other expenses being borne by the grain.‡ Table 2 gives details of one year's

* An addition has been made to cover the estimated extra cost of handling the larger crop.

† As used in calculations.

‡ The method adopted by the Committee on Agricultural Economics is that of charging one-seventh of the cost of the crop to the straw and six-sevenths to the grain.

production of straw. The total cost, after deduction of the cost of straw sold or used for other purposes, is charged to the farmyard manure now under consideration.

Table 2.—Actual Cost of Straw.

Crop, 1922.	Acres.	Estimated total tonnage.	Total cost. £	s.	d.
Wheat	332	314	587	3	11
Oat	315	182	361	6	3
Barley	187	68½	205	11	11
Rye	104	97½	129	8	7

Cost of Wintering.—The cost of labour and other expenses incurred on account of the cattle has been extracted from the accounts, and a summary of the cost of the wintering process is given in Table 3.

Table 3.—Cost of Wintering Cattle.

	£	s.	d.
Straw	784	0	0
Foods	991	13	4
Labour (man and horse)	245	13	9
Incidental expenses	74	6	4
Total	£2,095	13	5

The best method of reviewing the economic results of the practice would be to prepare an account showing on the debit side the cost of the wintering process as stated above, together with the cost of dealing with the manure (see Table 5), and on the credit side the value of any increase in weight of the cattle fattened and of any increase in crop-yields resulting from the application of the manure, minus the cost of dealing with such additional produce. The balance of this account would show, in terms of profit or loss, the primary result of the wintering process. Before reliable conclusions could be reached, it would be necessary to consider also certain other matters such as the building up and maintenance of soil fertility, the stocking of the grass land in spring, the effect of external factors such as seasons and markets, the reaction of the practice on the farming system as a whole, and the probable results of such alternative systems as might appear practicable.

Unfortunately, in the case under consideration, neither the increase in weight of the cattle nor that of the crops is known. Moreover, these are items which it would always be very difficult to ascertain on a commercial scale. It is therefore necessary to approach the problem from a different angle and to attempt a solution by a method which, though less exact, is nevertheless sufficiently accurate for the purpose in view.

This is undoubtedly a case where the farmyard manure must be regarded as the principal product of the wintering process. The management of the store cattle was not designed to effect any increase in weight, and none appeared to have resulted. There might, of course, be an increase in value without any increase in weight, owing to the relatively higher price of store cattle which sometimes prevails in the spring as compared with the autumn, and where cattle are required to stock the grass land in spring this point should be taken into consideration. It might, however, frequently be possible to secure this advantage more economically by wintering the store cattle on inferior pasture with the addition of some rough hay, were it not for the fact that farmyard manure is considered necessary for the arable land.

Cost of the Manure.—With regard to the cattle fattened and sold, winter fattening was not a primary object of the farming system, but was practised on the assumption that by this means some of the cattle wintered might be disposed of to the best advantage. The beef should therefore be regarded as a by-product of the wintering process, and its value should be deducted from the total cost of wintering to offset the additional cost of fattening as compared with mere maintenance of store cattle. It has already been stated that the increase in weight of the cattle is not known, but for the present purpose an estimate will serve. By reference to the number of cattle fattened and the length of time occupied by the process in each case, it was found that the total number of cattle-weeks represented is 1,440. Assuming an average increase per week of 14 pounds dressed carcass weight (which is probably in excess of the actual increase) we get an aggregate increase of 20,160 lb. If this is priced at 10½d. per lb. the total value increment appears as £882. The estimated net cost of the manure is therefore as shown in Table 4.

Table 4.—Net Cost of Manure.

	£	s.	d.
Gross cost of wintering (Table 3)... ...	2,095	13	5
Deduct estimated value of increment of cattle	882	0	0
Estimated net cost of manure in yards ...	£1,213	13	5

In addition to the out-of-pocket costs which have been specified, it is necessary to bear in mind certain contingent factors such as interest on the capital sum represented by the cattle, and the possibility of loss through disease, injury, death or a slump in prices.

To the cost of manure in the yards must be added the cost of handling in order to arrive at the total charge to the crops. The actual costs have been ascertained from the accounts and are shown in Table 5.

Table 5.—Total Cost of Manure Chargeable to Crops.*

	£	s.	d.
Cost of manure in yards (Table 4) ...	1,213	13	5
Cost of carting and heaping	186	0	1
Cost of carting to fields	239	10	6
Cost of spreading	57	3	2
Total charge to crops	£1,696	7	2

The total shown in Table 5 represents approximately the sum which must be charged against one year's crops, for, although part of the cost of the dressing will be carried forward against future crops, yet the proportion of the cost of manuring other fields in previous years, which is brought forward in the accounts, brings the total up to the full annual charge, subject, of course, to variations in costs in different years.

Cost of Dunging per Acre.—The area to be dunged each year is about 297 acres (one quarter of 1,188 acres), but part of the dung for this comes from other sources, such as horses, dairy cattle, young stock and pigs. It is estimated that in this way about 123 acres are accounted for, leaving 174 acres to receive the dung now under consideration. The cost per acre of the dressing on this basis is £9 15s.

The method of apportioning this cost over the rotation presents some difficulty, and should depend upon the particular nature of the crops grown and other local circumstances. Advisory economists have agreed upon a basis of 50 per cent. to the first crop, 30 per cent. to the second crop and 20 per cent. to the third crop. Supposing that wheat is the first crop the charge for dung would thus be £4 17s. 6d. per acre. With wheat at 12s. per cwt. and straw at a consuming value of 25s. per ton a minimum increase per acre of about 8 cwt. of grain and 10 cwt. of straw would be required to recover the proportion of the cost of dunging plus the cost of handling the increased crop.

Economic Results of Dunging.—Reliable information as to the economic results of dunging could only be obtained by properly costed experiments extending over a considerable period, in order that the effect of varying conditions might be observed. The ultimate effect on soil fertility of different systems both

* Overhead expenses are excluded from the cost of applying as this factor is very variable as between different farms.

with and without farmyard manure would, of course, be a most important point. The question for the individual farmer, however, is not so much whether the practice of wintering for dung pays, as whether it is possible to devise a system which will pay better. The answer to this question, and the details of any system which might be suggested, will, of course, depend largely upon local conditions. The most important of the general considerations involved, some of which have already been mentioned, may, however, be touched upon here.

(1) Provision must be made for the maintenance of soil fertility. The established practice in certain districts indicates that the application of farmyard manure is not the only means to this end. The ploughing under of green crops and "seeds" aftermath are other possible ways of supplying organic matter, while fertilising agents may be applied in the form of artificial manures and through the medium of cake and corn fed to sheep on the land.

(2) The most profitable crops should be grown, *i.e.*, those which promise the greatest excess of value over cost of production. This is a large question, with which it is impossible to deal adequately here. Some crops are principally valuable for sale, while others are wholly or primarily valuable for further production, *e.g.*, by feeding to live stock. One of the most important points for decision is whether land shall be used for the production of crops which are directly saleable or of crops which are consumed on the farm—the latter, of course, including permanent grass.

(3) Economical methods of production must be studied, and the general organisation of the farm, particularly as to labour requirements at different seasons, must be carefully considered. In this connection it may be noticed that, in the south at least, dung carting does not usually fit particularly well into the farm economy. It often has to be done when there is plenty of other work on hand for the horses and men. When wet weather prevails, the mechanical injury to the fields, as well as damage to roads, may be considerable. Twice carting the manure, even when not required for other reasons, is sometimes necessary in order to clear the yards for the cattle.

(4) Straw, if not manufactured into dung, will be available for sale and may thus increase the farmer's returns. At present there is a good market for straw in many districts, while the possibility of producing straw rope and straw envelopes on the farm is receiving considerable attention. Of course, if large

quantities of straw were offered for sale owing to the extensive abandonment of the manufacture of farmyard manure, the market would doubtless tend to disappear, but this is at present scarcely a contingency which need be taken into account by the individual farmer. Even if the straw is regarded as a by-product with no cost of production and having no value, that is not a valid argument for subjecting it to an expensive process of manufacture unless it is anticipated that an adequate return will be secured for the manure produced.

The following rotation, which was put into practice on a smaller farm under the same management as that for which figures have been quoted, will serve as an example of a system designed to take into account the considerations which have been mentioned, and to give good results in the particular case under present economic conditions:—

1. Fallow.
2. Winter Oats, followed by mustard ploughed under.
3. Barley.
4. Seeds, mown and grazed.
5. Seeds, grazed and mown.
6. Seeds, mown; afterwards ploughed under and bastard fallow given.
7. Wheat.

The intention was that no cattle should be wintered and no farmyard manure produced. Allowance was made for a dressing of 2 cwt. of sulphate of ammonia and 4 cwt. of superphosphate during the rotation. These quantities were calculated on a "subsistence" basis, and additional manuring for increased yield would be carried out if and when market conditions indicated that such a course would be profitable.

Before this rotation was adopted, the probable costs and returns were carefully calculated and compared with those for two other rotations which it was thought would also fulfil the essential condition of maintaining soil fertility without the application of farmyard manure. The estimates indicated that a satisfactory net profit might be anticipated in each case, but the above system promised the best results from this point of view and also from that of general organisation, and was therefore preferred to the others.

Conclusion.—Investigations of this nature, leading to results which promise large reactions over wide areas, provide a most important means by which agriculture may be assisted to regain a state of prosperity. A new system cannot well be proved before adoption by experimental trial (though what is novel in one district may be found well established elsewhere), but the extension of economic research, of which costing is an

important branch, will bring to light the defects of traditional methods and provide the means of forecasting the financial results of alternative systems. Scientific manuring and feeding, the improvement of the productive capacity of crops and live stock, and so forth, are of the utmost importance as material with which profitable systems may be constructed, but such measures are not in themselves sufficient to redeem the general agricultural situation when applied merely to traditional systems. A farming system is composed of various interacting factors. Natural sciences, interpreted and applied by the local knowledge and skill of the farmer, assist in the selection of the appropriate factors and indicate the nature and extent of their interaction, while economic science, a knowledge of which is of no less importance, applies the final test and provides the basis for comparison of alternative systems.

The wealth of experience which is the heritage of our generation must be interpreted and used in the light of modern scientific knowledge, but practice must not be fettered by mere tradition. It has been said that the farmers who weathered the storm of adversity some thirty or forty years ago were those who altered their methods to meet changed economic conditions. By this means agriculture in the pre-war years had regained some measure of prosperity, and by this means also the industry will eventually recover from the post-war depression.

* * * * * *

GUERNSEY CATTLE.

G. H. JOHNSTONE.

History.—In writing on the Guernsey breed of cattle one is impressed with an uncomfortable feeling that the reader has some title to expect to find at the opening some record of the history of the breed. Unfortunately in this case it is almost impossible to comply with such an expectation, for, going backwards, fact dwindles in so short a time into mythology that, unless fresh records come to light, this side must remain largely a matter for conjecture, however disappointing this may be to the student of the breed.

In the case of the Channel Island breeds this is the more to be regretted when we realise the interest it would afford could we trace the history and development of two breeds of cattle, apparently distinct, yet originating probably from a common stock; each having characteristics peculiar to itself,

and while developing on different lines, doing so within a distance of each other no greater than that from London to Windsor.

Tradition suggests that the Guernsey originated in a cross between "the large red cattle of Normandy and the small red cattle of Brittany"; but as the question of the origin of the breed has been the subject of special investigation by the monks in charge of Les Vauxbelets Agricultural College, Guernsey, it will be as well perhaps to give the conclusions arrived at as recorded in a letter by the Professor of Agriculture at the college.*

"Though the origin of the Guernsey cow be lost for want of definite historical record, inferences from known history of the people and from analogies of qualities and habits of the cattle in question permit the observer and student to draw conclusions which seem to point out the very breeds that have, in days of yore, contributed to the shaping and moulding of the modern Guernsey. One is prompted by study and comparisons to say that the most prominent ancestor of the Guernsey cow is the breed, not yet extinct, called 'Froment du Léon' in Brittany, France. This Froment du Léon, as to the size of frame, is a very small breed, much smaller than the present Guernsey, but possessing the same markings, quite distinct on the animal, namely, red and white, fawn and white, etc. It is active, gaudy, and is quiet at milkings."

"One of the reasons for its smallness may be ascribed to the country where it is bred and lives; there the grass is scanty and short, and the animal has to work hard to pick up a full feed. Another reason is the neglect with which the young stock is raised, the little care taken of it by the breeder even to this day, except a few well-to-do gentlemen who have lately taken steps to improve it by severe selection, better housing, and above all better feeding."

"Though the Froment du Léon animal be small, it gives a good flow of milk proportionate to the bulk of the beast. Hence by close analogy this cow seems to be the leading originator of our modern Guernsey."

"The second source from which the Guernsey has been formed was the introduction of Norman blood of the brindle variety of cattle, which is yet to be found in the rich butter district of Tesigny, and renowned as producing the best French butter. This breed is much heavier than either our modern Guernsey or the old Froment du Léon, and gives a good supply of rich milk."

"This second ancestor of the Guernsey is made obvious by the brindle cattle which, by atavism or reversion, often appear in the Guernsey breed, and also by the black-nosed cows which often are met with in the island. These brindle markings and black noses come, no doubt, from the Norman brindle. Besides, only a few years ago brindle cattle were quite common in the island and had a very good name as milkers."

"Now the crossing of these two breeds, the small Froment du Léon, and the bulky Norman brindle has given the medium size cow of Guernsey, in which there seems to be more blood of the first than of the other."

* *The Guernsey Breed*, Charles L. Hill (F. Kimble Company, Iowa, U.S.A., 1917).

FIG. 1.—Guernsey Bull, Lady Blanche's Slogan of Morland.

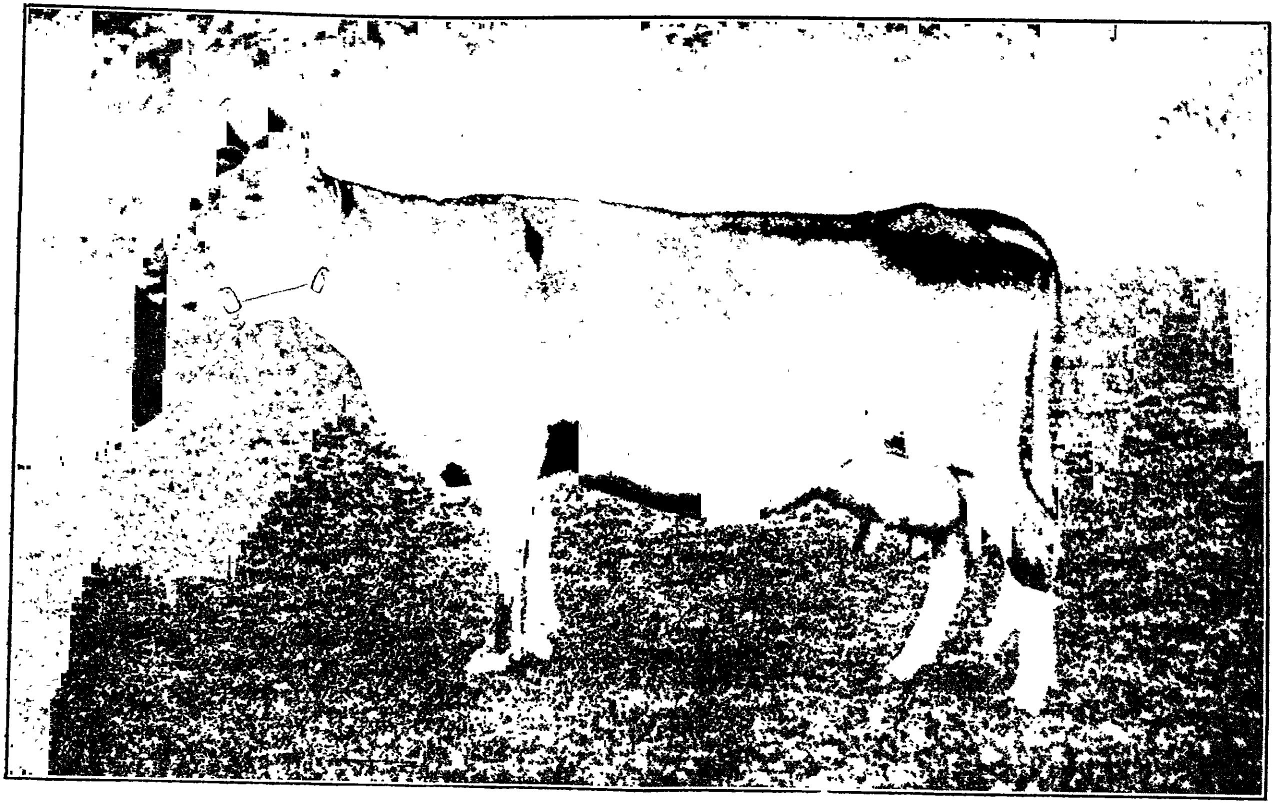

FIG. 2.—Guernsey Cow, Fussey's Dora.

"But when were animals of this breed taken to Guernsey; where resulted the cross? This is the very point on which no record can be found, yet no stone has been left unturned in the effort to discover some facts of the introduction and crossing.

"According to Norman chronicles, the Duke of Normandy sent some monks of Mont St. Michel to found a new abbey in Guernsey. This was about the year 960. Some years after, Duke William of Normandy gave the monks new land in the island on the condition that they would till the soil, teach the art of agriculture to the natives, and defend them against the possible encroachment of sea rovers."

"To cultivate so much land efficiently they had to import animals from the continent as draught beasts and also to supply products directly for their living, their diet consisting mainly of milk, butter and cheese. It is very probable that there were no cattle or only a few head as the natives were few in number and very poor."

"Now, nearly all the founders of this Abbey were Bretons, and it is therefore most natural that they should import cattle from their own country; besides they were the only body then able to import animals to the island, the natives being too poor and having no taste for breeding as they were all fishermen."

"Some years afterwards, about 1061, other monks came from Cherbourg. They established two new abbeys, one on Alderney, and one in Guernsey. These new colonists brought over Norman cattle of the brindle variety, for these settlers were Normans. The cattle they brought over were in the course of time crossed with the Froment du Léon. Good results crowned the efforts of the breeders. The bulky Norman breed gave stuff to the offspring, and the Froment du Léon gave lightness to the grade, which has in the course of years become the famous Guernsey."

"Such would be the origin of the Guernsey cow, and in the absence of any documents to the contrary, this version seems to be the only probable one."

So much for the history of the breed, as far as it can be traced, and if it be not conclusive, we may at least be content to render to the monks the credit for the early steps which have led up to the breed as it is to-day.

It is interesting to note that the prevailing colour is of comparatively recent development, and is certainly a concession to fashion; for we read in the preface to Vol. I of the "General Herd Book," issued in 1831:—"The colours of the Guernsey breed are white, red, and black, in any mixture and shade except roan, no instance of which is known to have occurred. Brindle is not uncommon. The nose may be either white or black." One herd of black and white Guernseys will be remembered by visitors to the island in quite recent years.

As to the purity of the breed, as it exists to-day upon the island, it is interesting to note that importation into Guernsey has been generally prohibited since 10th March, 1824.

Guernseys in England.—No exact dates can be given for the first importations of Guernsey cattle into England, but it seems that Channel Island cattle were more or less regularly imported into England in the early part of the 19th century. They seem to have come in under the comprehensive term "Alderney cattle," a term still used by many to cover anything that comes from the Channel Islands, although the only cattle on the Island of Alderney are hardly to be distinguished from Guernseys, to the characteristics of which they breed true.

Hampshire seems to have been the centre of the breed in these early days and we read in Youatt's book,* under the heading "Foreign Breeds of Cattle":—

"First among them—and a regular importation of which is kept up—we have the Normandy or Alderney cattle. The Normandy cattle are imported from the French continent, and are larger and have a superior tendency to fatten; and others are from the islands on the French coast; but all of them, whether from the continent or the islands, pass under the common name of Alderneys."

In the same book we read, under the title "Cattle in Hampshire," p. 215:—

"Hither also the Longhorns penetrated, and were the prevailing breed, but they may be said to have perfectly disappeared. They have given way to Devons, and indeed to breeds of every sort, and more particularly, near the coast, to the Alderney or smaller breed of Norman cows. About Southampton the Alderney is the prevalent breed."

No record is available to show when the breed first began to obtain a hold on the farmers in the far West of Cornwall, which may now claim to be the English home of the Guernsey. Often, of course, no attempt has been made to keep a record of the animals bred, so that they have become, since the foundation of the English Herd Book, "non-pedigree animals."

Of late years the progress which has been made by Guernseys in other parts of England has undoubtedly left its effect on the herds in the far West, especially amongst the non-pedigree animals, referred to above, which have been diligently sought out to add merit to the produce of mixed dairy herds in other parts of the country, so that a steady stream of "grade Guernseys" has been passing out of the Duchy. This is certainly due to the increasing appreciation of the value of Guernsey produce, and is reflected in a corresponding advance in the popularity of the pedigree stock, as may be seen in the

* *Cattle, Their Breed, Management and Diseases*, 1834.

progress made by the English Guernsey Cattle Society, and the number of animals registered in their Herd Book.

Founded in 1884, this society opened with a membership of 42, and the first Herd Book published contains a register of 309 cows and 74 bulls. By 1913 the membership had increased to 181, the cows registered in that year numbering 539, and the bulls 144. The last volume of the Herd Book, issued in 1924, shows that the membership has increased to 647, while 1,560 cows and 364 bulls appear in the register. This increasing popularity is the more remarkable when it is considered that the export of cattle to America has been at a complete standstill since 1918 owing to outbreaks of foot-and-mouth disease in England.

That the Guernsey is held in the highest esteem in the United States is shown by the thriving state of the Guernsey Cattle Society in that country, as well as by the number of cattle exported to the States from the Island of Guernsey, 396 animals having been shipped in 1923. It may be of interest here to give the results of the sale of the Langwater herd of Guernseys in New York State in 1922. This herd was bred (not bought) by the late F. Lothrop Ames, than whom there has probably been no greater scientific breeder of these cattle, and when sold by auction at his death, the 51 head offered brought an average price of $2,865, equivalent then to about £560.

Good prices for Guernseys, however, are also obtained elsewhere, and nothing is more encouraging to the Guernsey enthusiast in this country than the manner in which the breed has maintained its selling value during the slump in the prices of pedigree stock in England during the last few years. On 22nd July, 1923, an average price of £101 18s. 6d. was obtained for 42 cows and heifers, at the dispersal sale of the herd owned by Mr. D. C. Haldeman; 5 bulls offered at the same sale bringing an average of £120 15s. Moreover, at the time of this sale several buyers were out of action on account of local foot-and-mouth disease restrictions. If this disease is shortly stamped out in this country and our export market to America is again opened, it may safely be predicted that anyone having the right sort of Guernseys to offer will find a ready market for all he has to sell.

Constitution.—What is the right sort of Guernsey? As to form, this must be largely a matter of opinion, but as to constitution and dairy capacity there can be no divergence of view.

It may perhaps be regretted that in the scale of points published in the English Guernsey Society's Herd Book for the guidance of judges more account is not taken of constitution, unless indeed it is such a general characteristic of the breed that it has to some extent been overlooked. Not only are Guernseys hardy (several herds are wintered out day and night in the open) but as a breed they are singularly free from tuberculosis. On this, no doubt, the island stock, which is constantly being imported for the replenishment of English herds, exercises an important influence, for the precautions taken in Guernsey have been so successful that complete freedom from the scourge can be claimed throughout the island.

The special regulations for combating bovine tuberculosis in Guernsey are very complete and provide for compensation in the case of animals which are compulsorily slaughtered on being found infected. The first known case of the disease there was some years ago and was found in a bull which had been sent to England for exhibition at one of our principal shows, and subsequently returned to Guernsey for breeding purposes. As soon as it was discovered, the disease traceable to this source was diligently sought out and eradicated by slaughter wherever found; moreover, the re-importation of cattle exported for showing, or any other purpose, was thenceforward prohibited.

If longevity is accepted, as it surely must be, as evidence of constitution, the Guernsey cow can certainly enter the lists without fear of rival breeds exceeding her records in this respect. It is no uncommon thing to find cows of this breed of 18 or even 20 years producing enough milk to justify their being retained in the herd, besides bringing to it the annual increase of a calf, while at 13 to 15 years of age they will constantly be found holding a good position in the herd as milkers. Moreover, the distribution of the breed is a testimony to its vigour and hardiness. We find Guernseys not only in Northern England and Scotland, but all over the United States of America, in Canada, even in Alaska, in tropical Brazil, in South Africa, Australia, and Japan, while a few have even reached China.

Fashions in Breeding.—There is a mistaken tendency, no doubt due to the influence of the show ring, to breed Guernseys smaller than heretofore, a tendency which, if they are to occupy the prominent position as dairy cows to which they are entitled, rather than to degenerate into that of an ornament for gentlemen's parks, should be checked before it has had time to do the

harm to the breed that it undoubtedly will. The aim for the future should be to breed them large and "rangey" without loss of quality, aiming at the same time to get a development of width behind to replace the present tendency to narrowness there. There can be no doubt that this tendency to breed smaller (show ring) Guernseys is due to the fact that quality is more easily recognised in small than in large animals, but Guernsey breeders will do well to set their faces firmly against the fashion. The Guernsey cow should scale her 1,000 lb. without sacrifice of quality.

While appreciating the many and real benefits that the show ring confers, it is at the same time impossible to disregard the influence exerted by fashion through this channel, as is exemplified in the demand for white noses in Guernseys. While it is manifestly impossible to suggest that the colour of the nose exerts any influence on the milk yield, it is a very prevalent opinion, both in England and in the Channel Islands, that a black nose is an indication of milking capacity. This may perhaps be accounted for to some extent by the fact that unless the strain from which the black-nosed heifer has been bred renders it probable that the calf will ultimately prove rather exceptional as a milker, it would not have been kept to grow up with the herd. However, it is well to remember that only a few years ago the black nose was considered to be no disfigurement, and that it is only in deference to the Moloch of fashion that it has come to be looked on with so much disfavour. It is conceivable that at some future time the tide of fashion will change; some millionaire will develop a taste for black-nosed Guernseys, and we shall then all try to breed them. In the meantime it may be as well to mention that the black is very "recessive" and can easily be bred out of a herd so long as in-breeding is not closely practised. For this reason, those who wish to start a herd on the most economical lines should not lose the chance of obtaining a bargain when they find a cow going cheap because she has a dusky nose.

With a bull, of course, it is different, for while the cow is responsible only for one annual addition to the herd, the bull may be expected to father all the increases in it.

Milk and Butter-fat Records.—Above all it is essential that the Guernsey cow shall milk well, and that the butter-fat content of the milk shall be materially in advance of that given by the so-called dual-purpose breeds—for she does not claim to be in this category—and if she does not offer dairy produce of a

quality considerably in advance of that of the so-called dual-purpose breeds, she can have little claim to remain in the herd.

The average yield of the mature Guernsey would probably work out at between 600 and 700 gallons, though, of course, a great number of animals exceed this, as is shown by the list of certificates granted by the English Guernsey Cattle Society. These certificates are offered by the Society for animals complying with certain standards laid down for yield of butter-fat, and an inspection of the list of certificates issued in 1923 shows that in the class for mature cows, the average yield of the 54 included was 8,918.38 lb., while the average butter-fat percentage was 5.10. If 80 per cent. of butter consists of butter-fat it will be seen that each of these cows has produced more than half her own weight of butter in the year!

One effect of the increasing popularity of milk records has certainly been to increase the yield of milk, as may be seen from the records of the various Milk Recording Societies which are published from time to time; but the system as at present supported by the Ministry of Agriculture takes no account of butter-fat content. For this reason the English Guernsey Cattle Society, while working under the Ministry's system, has at the same time wisely retained the issue of the certificates which have for many years been awarded on a butter-fat qualification.

Butter from milk of the Channel Island breeds, when properly made, has a substance, a flavour, and a colour considered by many as unrivalled by that of any other breed, and it meets with a very ready market; while the present-day demand for clean milk cannot fail to bring a discrimination as to quality as well as cleanliness, of which the yellow milk of the Guernsey, topped with a thick layer of rich cream, offers a tempting advertisement. To this may undoubtedly be attributed the exhilarating popularity of the Guernsey amongst the dairy farmers of the United States to-day; for we find not only an increasing number of pedigree herds of this breed in that country, but also a greatly increasing demand for Guernsey bulls for use for "grade" purposes. They have been proved to mate well with other breeds which lack the supreme quality of Guernsey produce, and breeders in this country should not be slow to appreciate the value of this trade in this country also for the disposal of their bull calves.

The increasing interest taken in milk recording is already bearing fruit in the number of bulls advertised for sale from

milk-recorded stock, sometimes into the second, third and even fourth generation, and the day is certainly not far away when those who have bulls without milk records behind them will have difficulty in finding a market.

Here again the influence of the show ring has not been wholly for the good of the breed, for there are many who will buy a young bull solely because he is likely to win prizes at the shows, but without regard to the fact that all the money won there may be much more than discounted by the harm he will do in lowering the standard of milk production in the future herd. It certainly should be a question for the consideration of the Council of the breed society whether, at any rate, the championship classes at the shows for which they offer the prizes should not be restricted to bulls out of cows which hold the society's certificate for milk yield.

Types and Lines.—The great development in the demand for Guernseys is, of course, reflected in the price paid for even indifferent representatives of the breed. It is surely a matter for regret that in this country, so famed for the breeding of pedigree stock, greater efforts are not made to discourage the breeding of "scrubs" under the cloak of registration figures. Some pedigree breeders who are themselves the most resolute in their protection of the pedigree, are at the same time most lax in the prostitution of their ideas, submitting for registration animals whose only title thereto lies in the mating, however carelessly, of two pedigree animals.

How many incipient breeders of any sort of cattle have given up after their first experience of investment in the breed they intended to keep? In the same matter of starting a herd, how many give a thought as to how to go about it before they begin? A brief preliminary study of the Guernsey herd books will amply repay the time spent upon them by an intending beginner, for he will learn from them which are the most popular families of the day as well as which are the best milking strains. He will learn, too, that while certain "lines" have retained prominence over a number of years and are still in favour, others which may perhaps have occupied a position of similar prominence for a time have gradually died out or are dying out.

He will be wise, too, if he sets himself determinedly to restrict his selection to one type. In this breed there are several types, and in many of the herds in this country there

is a lack of uniformity of type which not only detracts from the appearance of the herd, a matter of secondary importance, but which at the same time greatly adds to the problems of mating.

It is well known that the mating of a bull of one type with a cow of another frequently results in disappointment; especially is this so when both sides of the union are animals which may have won the highest honours in the show ring or in the milking shed. If the beginner purchases, say, three different types, he will find himself faced with the difficulty of deciding which of them shall be favoured in the selection of his herd sire. With Guernseys this difficulty is a real one, for no type has been fixed for the breed, neither is help afforded by the judging records.

Feeding.—In claiming for the breed pre-eminence as an economical dairy proposition, the question of feeding cannot be left out of account. The Guernsey is a thrifty cow, able to satisfy her needs on pasture which is not of the highest quality, supplemented during the winter months by less roots and concentrates than are needed by cows of a heavier frame. In the modern system of calculating the maintenance requirement of food by the weight of the cow, and her production requirement by her yield of milk, the Guernsey compares well with any other breed, while the ability to maintain herself on ordinary pastures adds greatly to her economic value.

On the Island of Guernsey, where much of the available land is devoted to market gardening under glass, the cows, and often the bulls, are tethered from an early age by means of pegs 8 to 10 in. long driven into the ground, having chains or ropes attached and secured through a swivel to the horns, the pegs being moved at frequent intervals during the day. The proverbial docility of the breed is often attributed to this method of tethering, practised for many generations. It may be suggested that if this be so, the same docility should have been inherited by the bulls. While it cannot be denied that bulls of this breed do at times give a certain amount of trouble, it should at the same time be remembered that they are often condemned from an early age to a life of more or less solitary confinement, while sometimes the ministrations of the feeder will include demonstrations with either a fork or the voice which render him unwelcome in spite of the food that he brings! It has been observed by the writer that at those farms where "ugly" bulls are unknown, the conditions of stabling

admit of the bull being allowed to see something of what is going on around him.

Registration in Guernsey.—Reference has already been made to the value of the island as a centre from which the herds in this country may be replenished, for all animals from there must, of course, be descended from pedigree stock. Even so, the system of registration in the island is very carefully conducted, and a calf, to be registered as pedigree stock must be sketched by an official draughtsman of the Society within a few hours of birth. The date of service must also have been officially notified, and a certificate of service obtained from the owner of the sire. A calf not qualified under these conditions can never be registered as " pedigree " stock. It may, however, in due course be presented before representatives of the Society, and if approved by them as being sufficiently representative of the breed, it is admitted to the Herd Book as " foundation " stock, without any entry in the records as to pedigree. The Island Herd Book is, therefore, divided for this purpose into pedigree and foundation stock. Notification of these periodical inspections is given from time to time, and centres are chosen to which animals may be brought for the purpose of securing qualification.

Although the breeding of these foundation animals is not entered in the Herd Book, their parentage is often traceable, while they are, of course, possessed of as much Guernsey blood in their veins as any with the longest pedigree.

In the battle of the breeds, which during the last few years has doubled in intensity, the Guernsey has more than held her own, as the figures given above of the progress of the English Guernsey Cattle Society indicate. While those who set out on the road to find the best breed of dairy cows will find that the road is a long one, and leads nowhere, they will certainly not be able to pass over the claims of the Guernsey as being the world's greatest butter producer, if the standard of measure be one of quality and economy of production. When the public of this country have been educated to judge the food value of milk by its quality, the Guernsey cow will meet with a wide appreciation of her ability as a rent-paying proposition.

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ENSILAGE.—IV.

CLAMP SILAGE.

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THE making of silage in a tower silo involves considerable expenditure for the construction of the silo, the purchase of a cutter, and perhaps an engine to drive the cutter. Clamp silage has the advantage that it can be made without any such capital expenditure. This method can consequently be brought into use at very short notice for the preservation of fodder in periods of abundance, or alternatively in periods when wet weather prevents haymaking. At the will of the farmer it can, therefore, form part of the annual farming procedure, or be utilised only under the circumstances mentioned above.

Difficulties.—It must not be thought that clamp silage can be satisfactorily made without care; there are, in fact, two important dangers to be avoided.

(1) The first of these is wastage on the top and sides of the clamp, which may reach excessive proportions—25 per cent. or more—when conditions are bad. It will readily be gathered that this wastage is proportional to the area of the exposed surface, and that consequently a small silage clamp suffers greater proportionate wastage than a large one, because it has relatively more exposed surface. It is not, therefore, a practice suitable to small scale work nor for small holders, though it is sometimes suggested for them.

(2) The second difficulty is due to the fact that the silage in the lower part of the clamp is liable to be very sour, owing to the solid packing of the silage on the floor of the clamp due to the carting of the full loads of crop over the clamp, and to the difficulty of access of air to this part of the clamp—surrounded as it is by the impervious earthen walls.

The Site.—This should be chosen with care. In some cases, when it is proposed to make clamp silage annually, the site is selected in a convenient part of the stackyard. In other cases it may be in one corner of the field where the green crop is growing. If it is possible to place it adjacent to several fields, then the site can be used for crops on each of these in succession. Again, if the silage is to be fed to cattle or sheep in a near-by field or yard, proximity to this should have consideration. By making the clamp in the field the labour of carting it may be considerably reduced, but it is important that the site selected be close to a road for carting from the clamp in winter.

One other point in selecting the site is to make sure that the bottom of the clamp, when excavated, is not subject to flooding in winter.

The site of the clamp is prepared by excavating a pit of varying depth according to circumstances. If the pit is in the field the depth should generally vary from 12 to 24 in.; this will provide soil sufficient to cover and weight the clamp when completed. If the pit is to be permanent and situated at the homestead, the depth may be 3 to 4 ft., provided drainage is satisfactory; where such a comparatively deep pit is dug it may be desirable to concrete the sides roughly to prevent the walls falling in The sides should not be quite vertical, but should have a slight slope inwards to the floor of the clamp (see diagram); this will both help to support the sides and also provide for more perfect packing of the silage in the clamp.

The other dimensions of the clamp also need careful study. The width should be sufficient to allow loaded carts of green crop to be led over the clamp when it is being made without danger of toppling over, and yet not unduly wide because when the silage is being used it will be cut off in sections across the narrow width. If the face is too great a comparatively long period will elapse between the cutting of each section, and the exposed face of the silage will have begun to decay before being used. Experience has shown that a width of 14 ft. at ground level provides best for these two considerations, though according to circumstances it may vary from 13 ft. to 16 ft. with good results.

The length of the clamp will of course depend upon the amount of crop to be ensiled. In calculating the weight of silage from a green crop in the field it may be taken as varying between $\frac{2}{3}$ and $\frac{3}{4}$ of the weight of the green crop concerned, or the crop may be estimated in terms of the weight of hay it would produce and then multiplied by 3 to convert weight of hay into the equivalent weight of silage. Having obtained an estimate of the weight of silage to be clamped, this must be divided by 40 to convert pounds of silage into cubic feet, since 1 cubic foot of silage weighs on the average 40 lb. The height to which the clamp of silage will ultimately settle will depend upon a variety of circumstances, but generally it will be found to vary between 4 ft. and 6 ft.—say a mean of 5 ft. If, therefore, the estimated quantity of silage in cubic feet be divided by 14 ft. (the width of the clamp) and again by 5 ft. (the ultimate depth of silage) the length of clamp to be excavated will be obtained.

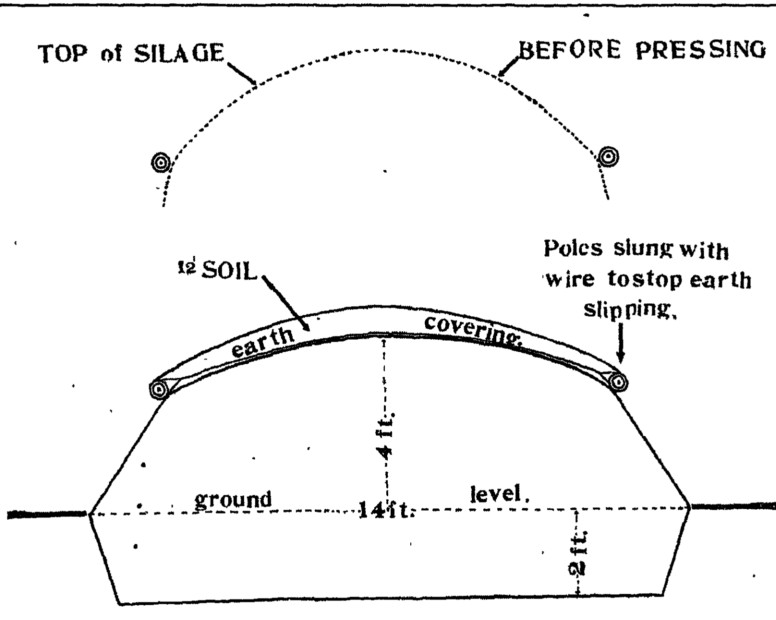
Formation of Clamp.—A clamp silo is generally made in exactly the same way as a drawn-up clamp of farmyard manure, that is to say, each loaded cart of green crop is led over the clamp, tipped off behind, and the greenstuff roughly spread. This, as previously mentioned, results in excessive pressure on the lower layers in the pit, where air has little access to the heap, with the result that when other conditions are favourable —*e.g.*, a damp, succulent and perhaps immature crop—sour silage results. It might be expected that such conditions would give rise to green and fruity silage in the clamp, but so far this has not generally been the result. Sour silage may be prevented by allowing the fodder at the bottom of the clamp to wilt for a couple of days before carting, in which case the crop will be drier and lighter when carted. The pressure on the clamp being in consequence less, the air has readier access, more heat is generated by fermentation, the temperature rises to a higher point in the drier material and sour silage is prevented from forming. Alternatively, the first day's work on the clamp may be stopped when a depth of only 2 to 3 ft. of silage has been placed over the floor of the clamp, and the clamp left for a couple of days during which considerable heating will result, since it will not be too closely compacted. With this heat below, the building of the rest of the clamp can be steadily pushed forward, and it will be found that the silage will heat normally.

In building the clamp the sides above ground should be constructed so that they slope slightly inwards, but this must not be exaggerated because as fermentation proceeds and successive layers of green crop are added the clamp will settle greatly and consequently the slope of the walls will be increased. When the clamp rises much above the level of the ground a trace-horse will be necessary to help draw up the loads. The trace-horse should be kept at the clamp, and in the intervals between the loads led along the sides of the clamp to trample these tight, otherwise the sides may be too loose.

The building of the clamp should preferably be continued intermittently over a period of not less than eight days, in order to give time for the several layers of silage to ferment and settle down, so that the heap of silage when completed may have a considerable height. The height of the clamp can never be carried much more than 7 ft. above ground level at any time, because of the danger of the carts overturning, so that if the clamp is rapidly completed it subsequently settles to a very small clamp. When intervals are allowed in the clamping, these

should not be greater than two clear days, lest moulding should begin to take place on the exposed surface.

Covering the Clamp.—It is important to give special attention to the construction of the roof. There is a danger of overheating and excessive drying out of the top layer, as in the tower silo, and this can be obviated as in the tower by using very succulent material on the top, or better still by using some succulent waste material, if available. Again, it is most important to obtain the right shape to the top in order that the greater part of the rainwater can be shed by the slope of the roof; otherwise the water tends to soak into the clamp and leads to the decay of much silage at the eaves. For this purpose mention has already been made that the side walls, as built, should slope inwards; in completing the roof this process must be continued and accentuated by heaping up the centre by hand after the sides have been so drawn in that it is no longer possible to cart with safety over the clamp (see diagram). When the last load has been carted upon the clamp, a short part only of the toe of the run up at either end should be cut off,



CROSS SECTION OF SILAGE CLAMP.

leaving a considerable slope, and the material pitched upon the sloping ends of the clamp, since otherwise the greater part of this toe will be spoilt before the silage is used.

Perhaps the most important part in making clamp silage is the covering or pressing of the clamp with the soil excavated from the pit. The first precaution is to commence covering immediately the clamp is complete, because delay means additional wastage. The proceedure in covering a silage clamp should be exactly the reverse of that adopted in covering a clamp of mangolds. Instead of building up the covering from the sides, one should begin by throwing soil on to the centre of the top of the clamp. The reason for this is that the clamp is continuously settling, and if the earthing proceeds as with a mangold clamp, then, as soon as the earthing is complete, this forms a sort of arch which partially supports itself and prevents the compacting of the heap. If the procedure recommended above be adopted, it will be found, however, that a difficulty at once arises: the soil keeps rolling off the eaves. This difficulty is easily overcome by slinging large poles, about 4 to 6 in. in diameter, on either side at the eaves of the clamp by means of old fence wire passing over the heap. The soil lodging upon these poles is prevented from rolling off and a covering is quickly effected; moreover, the greatest thickness of soil will accumulate just above the eaves where the greatest pressure is desirable. Another advantage of this method is that the pressure of the soil is immediately applied to the top of the clamp which rapidly settles down, air is excluded and excessive heating of the top layer is prevented. The best depth of earth covering is probably 12 in.: a smaller depth is often adopted in practice, but this leads to greater waste. The diagram shows a section of a silage clamp which has been covered with earth as described and allowed to settle.

It is a matter of opinion whether, when the top of the clamp is covered, one should proceed to earth-in the sides; in general practice this is done, though mechanically it can exert but little pressure and may, as already stated, even tend to lessen the pressure. In one trial at Cambridge in a clamp one side of which was earthed and one not, there was no measurable difference in the wastage on either side. It seems probable, therefore, that earthing the sides is unnecessary.

Wastage.—It must always be realised that the making of clamp silage is liable to lead to excessive wastage by moulding and decomposition unless suitable precautions are taken, and

that this wastage is progressive, so that a clamp or part of a clamp kept till March will have wasted very much more than one used in early autumn. One is frequently asked between what limits such wastage is likely to lie, and for this reason calculations of wastage have been made. It is not claimed that the figures for the two clamps to be quoted are extremely accurate, but they give an approximation to the truth.

(*a*) In the first case the clamp was made from a third crop of clover and ryegrass, in September, 1920, following the directions given previously. The pit was 2 ft. deep, and the green-stuff was packed together well. The clamp was covered immediately it was completed with a covering of soil 12 in. deep. The autumn was dry and the measurements were made in mid-December after two-thirds of the clamp had been used, when its mean height was 4 ft. 9 in. In this case the estimation of waste was made by measuring the depth to which moulding had occurred as shown by the section across the clamp from which the silage was cut. These measurements varied from as little as 1½ in. over the centre of the clamp to as much as 5 in. at the eaves. From these and other measurements the areas (1) of the whole cross section of the clamp, and (2) of the mouldy covering, were calculated; and from these the percentage of wastage by volume was calculated. The result showed that no more than 5.7 per cent. of the silage had been spoilt, which may be taken as a very good result of careful management.

(*b*) In the second case the clamp was composed of a long and twisted crop of oats and tares with some rye, which did not lend itself to close packing on the surface. The pit was 2 ft. deep and generally the procedure was as described above, except that a delay of two or three days occurred between completion of clamping and covering of the silo, and the earth covering amounted only to 6 in. instead of 12 in. The clamp was made in June, 1923, a year in which the autumn was very wet, and this favoured wastage. The measurements were not made until 15th January, 1924, when the clamp was nearly finished.

The method of estimation in this case consisted in cutting a rectangular block of silage down through the clamp at a point midway between the centre of the silo and the side, at a point where the wastage appeared to be about the average. The weights of both good and bad silage were determined, and then the percentage of dry material in both good and bad silage was determined from samples of each. From these measurements the wastage was calculated and found to be 19 per cent.—a

result which shows that wastage may be very great when conditions of making and control are imperfect. The figures of wastage by moulding at the sides do not include wastage due to fermentation.

Summary.—It may be said that, when conditions are unfavourable for hay-making, clamp silage is a useful method of saving excess of green fodder for winter feeding in a succulent form, provided that the crop is a suitable one, that clamping is properly carried out, that covering with soil is done intelligently and quickly after clamping is complete, and that in addition the silage is used reasonably soon after making. Clamp silage is not likely to be successful if made in too small clamps, nor if used too slowly, so that the cut surface remains exposed for considerable periods. Clamp silage entails no capital expenditure beyond the labour of digging the pit, and is therefore applicable for occasional use. A few farmers have made clamp silage part of their regular farming scheme, but this practice is not general. Where adopted for this purpose it is usual to prepare rather deeper pits, to have them situated near the homestead, and to strengthen the face of the walls with concrete or other means.

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THE RESEARCH ASSOCIATION OF BRITISH FLOUR-MILLERS.

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BEFORE the War, the competition of imported flour had been overcome by the British flour-milling industry to the extent that approximately 90 per cent. of the national requirements were met by home manufacture. A large part of this was, of course, milled from imported wheat, the proportion of home-grown flour being about 17 per cent. During the War, flour was imported in preference to wheat, in order to economise in shipping space, and at the end of the War flour-millers were much exercised by the necessity which faced the industry of regaining and surpassing the earlier position. It was realised that the industry must avail itself of all possible means of improving the efficiency of its processes and the quality of its products, and that research along these lines was desirable and in fact essential. In such work individual effort, while indispensable to individual success and prosperity, is not enough. It

is possible for only the very largest firms to undertake continuous research into many problems the solutions of which lead to improved processes or reduced costs. Only by co-operative effort can smaller firms carry out investigations on any adequate scale or provide facilities for inquiry into technical questions, both of general and particular interest.

Formation of the Research Association.—It was for these reasons that in April, 1920, the Education Committee of the Incorporated National Association of British and Irish Millers submitted a report to the Council of the Association recommending the formation of a Research Association for the flour-milling industry, and by September, 1920, a definite scheme had been developed by the Committee and approved by the Council. Later a special Committee was appointed to carry on the necessary propaganda work.

The Research Association of British Flour-Millers was finally incorporated on 8th September, 1923. It is supported to the extent of £2,500 per annum by annual subscriptions from its members, while the Government, through the Department of Scientific and Industrial Research, have agreed to contribute a further £2,500 annually for a period of five years. Should the membership and consequently the income from subscriptions increase the Government grant will also increase on a £ for £ basis up to a limiting grant of £4,000 per annum. By the terms of the Government grant none of this income can be used directly on a concern run on ordinary commercial lines for profit such, for example, as a commercial flour mill. As, however, it was regarded as essential that such a Research Association should have as part of its equipment a mill running on commercial lines, in which the results of experimental work could be checked and developed upon a practical commercial scale, it has been found necessary to establish two separate organisations which are financially distinct:—

(1) The Research Association, which is in the form of a Company, not trading for profit, limited by guarantee; and

(2) The demonstration mill, which is organised as an ordinary limited company under the name of the British Flour Mills, Ltd.

A long lease was obtained of the New Barnes Mill, Sopwell, St. Albans. This mill has a capacity of 5 to 6 sacks of flour per hour and is being brought up to date by the replacement of much of the existing plant by new and larger machines, many of which have been presented to the mill by the manufacturers.

The control of the mill is in the same hands as the control of the Research Association, the Board of Directors of the Milling Company being, with the exception of one member, identical with the Executive Committee of the Research Association; this is essential in order to ensure co-operation and co-ordination of effort between the scientific and the commercial organisations. Moreover, power to hold shares in the Milling Company is restricted to members of the Research Association, and all members of the Association are required to hold such shares in proportion to the capacities of their mills.

The Research Association is administered by an Executive Committee of six members, while broad questions of general policy are dealt with by the Council—a body of twenty-three members, three of whom are appointed by the Department of Scientific and Industrial Research. These are Sir John Russell, D.Sc., F.R.S., Professor T. B. Wood, C.B.E., M.A., F.R.S., and Dr. C. R. Young, C.B.E.

The senior scientific and technical staff consists at present of a Director of Research, three chemists, and an assistant analyst, and a baker will be appointed as soon as the experimental bakehouse has been built and equipped. Provision is also being made in the new laboratories for a biologist.

Buildings.—Considerable difficulty has been experienced in the acquisition of suitable laboratory accommodation, owing mainly to the necessity of the laboratories being in the immediate neighbourhood of the mill. As no existing building could be found within easy reach of the mill that could be adapted as laboratories and where gas, water and electric light and power services were readily available, it has been decided to acquire a suitable site about a mile from the mill and to build the necessary laboratories, administrative offices and bakery on it. It is hoped that these buildings will be ready for occupation in the early summer of 1925. Meanwhile a house, situated within 300 yards of the mill, has been taken over as administrative offices, library, etc., and a vacant block of laboratories belonging to the Lister Institute of Preventive Medicine, at Queensbury Lodge, Elstree, Herts, has been rented for one year.

The new buildings will contain three laboratories (chemical, analytical and biological), Director's room, library, office, workshop, a constant temperature and humidity chamber and ample storage accommodation; and the site is sufficient in area to admit of considerable extension to the buildings as future requirements may necessitate.

An experimental bakehouse is considered to be necessary, since the baking test is the ultimate test of the miller's main products. Such a bakehouse is to be erected as a separate building on the laboratory site. Proving cabinets and ovens will be installed for baking normal 2 lb. loaves and small ½ lb. loaves. The latter are considered necessary as baking tests will frequently be desirable with small quantities of flour only, *e.g.*, in the case of the laboratory conditioning of small wheat samples or in the examination of new varieties that may have been grown on small experimental plots. Moreover, it will frequently be necessary to make a considerable number of baking tests, under various conditions, on samples often too small to allow of 2 lb. loaves being obtained.

In addition a small model mill is to be installed, for milling operations will frequently be necessary on small quantities of a few pounds. The value of such a small mill, however, is wider than is indicated by the necessity of milling small laboratory samples of wheat. There are many problems in flour-milling that are difficult to attack under commercial conditions in a full-sized mill. The temperature and humidity of the atmosphere, for example—both of which vary greatly from day to day or even from hour to hour—have important effects on the milling processes as well as on the products. The study of "manufactured weather" as the Americans rather aptly express it, that is, the study of temperature and humidity control in connection with flour-milling has not made great strides in this country, although such control is the rule in the great textile trades. It is a difficult and costly matter to experiment along such lines in a commercial mill, but such working conditions can be easily controlled and varied with a model mill.

Programme of Work.—The work of the Research Association it to be divided, broadly speaking, into three branches, viz., the library or information bureau, the analytical and advisory work, and pure research work.

The library will contain ultimately, it is hoped, all publications, both scientific and technical, in English, German and French, that bear directly on the milling industry, or concern the raw materials and the products of the industry. In addition, the mass of material dealing with cereals and cereal products, starches and proteins, which is to be found scattered in scientific journals in other libraries has to be abstracted and collated so that research workers may know what work has been done on any particular subject. The importance of such an information bureau as this to a band of scientific workers is very great, and,

besides this, it is hoped to issue, for the information of members, bulletins based on the published literature on various problems of the industry, such, *e.g.*, as conditioning or bleaching.

The second branch of the Association's activities is advisory work. It is not intended that the Association shall undertake ordinary routine analyses for its members; such work falls naturally to consulting and analytical chemists. But it is hoped that when millers are up against difficulties or complaints respecting the quality of their products they will turn to their Research Association for help. In such cases samples will be analysed, and when necessary baking or other tests carried out and reports based upon such tests issued to the members concerned.

The section of the work dealing with pure fundamental research will be a thing of slower growth. In this branch most of the problems are concerned with the question of *quality* in wheat and flour. Conditioning is perhaps next to quality in the miller's mind, and although it is undoubtedly a long way behind quality in importance it has important connections with it.

A really comprehensive attack on the problem of quality can be made only by the united efforts of the chemist, physicist, biochemist, plant and animal physiologist, geneticist and practical miller and baker working in close collaboration. It is impossible that all these branches of science should be represented on the Research Association staff, but it is hoped to work in collaboration with other Research Institutes.

These are the three main branches of our activities, but they are not to be regarded as in any sense water-tight compartments. The three branches will work in close association, each will be vital to the work of the other two, and the only separation between them will be the merely physical one of a few inches of bricks and plaster.

These ideas were elaborated and extended into a paper on "The Field for Research in the Flour-Milling Industry," which the Director of Research read at the Convention of the National Association at Folkestone in June, 1924.*

Following on this general survey of the whole field of research a special research programme has been drawn up by the Director of Research. A summary of the programme, which has been accepted as the official research programme of the Association by the Council of the Association, is given below.

It is impossible to carry out investigations in every branch of the industry. Research will be commenced along a few promising lines, and as the work progresses fresh problems will present

* See *Milling*, 21st June, 1924, and *The Miller*, 7th July, 1924.

themselves. In suggesting fresh problems for investigation the advisory work carried out for members by the Research Staff will be of great value.

The following scheme comprises the main lines of work contemplated. The sections indicated by an asterisk are those on which attention will first be concentrated.

*1. A study of the flour stream of New Barnes mill.

*2. A comprehensive study of two wheats, one strong, *e.g.*, No. 1 Northern Manitoba, and one weak, *e.g.*, an average sample of English, excluding Yeoman, and of flours and flour blends obtained from them. The following eleven series of flours will be studied: 100 per cent. No. 1 Northern Manitoba, and mixtures of No. 1 Northern Manitoba with 10, 20, 30, 40, 50, 60, 70, 80 and 90 per cent. average English, and 100 per cent. average English.

*2A. The effect of storage under a variety of conditions on both wheats and flours.

*2B. Conditioning of the two reference wheats:—

(1) A study of water absorption, by and drying, of single berries.

(2) Conditioning at various temperatures and at various humidities.

(3) Effects of damp on wheat and flour.

3. Wheat and flour survey of the country:—

(A) It is hoped to take up the work of the Home Grown Wheat Committee by working in close connection with other institutions interested in wheat growing and wheat breeding. In this connection a study will be made of:—

(a) new varieties;

(b) effects of environmental conditions on different varieties especially with a view to

(c) finding the varieties best suited to local conditions.

(B) Besides growing the most suitable wheat locally, each local miller wants to mill the most suitable flour; moreover, the best flour in one district is not necessarily the best in another: hence a comprehensive study of flour standards and flour grades will be made, *e.g.*, samples of a miller's best flour will be compared—

(a) with other good samples from other districts;

(b) with inferior samples from the same and other mills.

*4. The study of certain physical-chemical and colloid properties of flours and flour blends in relation to baking quality.

*5. The study of improvers and their effects on baking quality and other properties of flours. (This partially comes under 4.)

6. Flour bleaching.

7. Physiology of the wheat berry, including respiration of wheat in relation to commercial storage and ageing.

8. Chemical, physical and biological study of the changes occurring during doughing and baking.

9. The staling of bread, especially in relation to flour quality.

10. Physical and physico-chemical study of the actual processes of converting wheat into flour: the physics of milling processes, *e.g.*, the study of mill conditioning (as distinct from wheat conditioning), of crushing and grinding and of sifting by sieves and air currents.

11. Wheat offals, especially with a view to standardisation and grading.

It will be seen from this summary of the Scheme of Research that there are many points of contact between the work of the Research Association of British Flour-Millers on the one hand and agricultural research on the other. This is indicated more especially by Sections 2, 3, 4, 7 and 11. It is hoped, as already stated, that it may be possible to carry out collaborative work both with institutions and with individual workers under the Agricultural Research organisation. Much useful work might be done in the Association's laboratories, mill and bakehouse in collaboration with members—teaching, research or advisory—of the staffs of Agricultural Colleges and of the Agricultural Departments of Universities, and with the Agricultural Advisory Officers of the various counties especially in connection with the wheat and flour survey of the country covered by Section 3 of the Research Programme. The influence of weather on the wheat crop is another example of collaborative work that might be carried out to the mutual advantage of the farmer and the miller. An investigation of this nature in connection with barley is being carried out under the ægis of the Agricultural Education Association. A similar programme in connection with the wheat crop is desirable, and the Research Association would welcome an opportunity of collaborative work of this character.

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THE GOUT FLY OF BARLEY.

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THE Gout Fly (*Chlorops taeniopus*) is a well-known pest of barley in many parts of the country. Comparatively little attention has been paid to this insect since the year 1870, when the Austrian entomologist, Nowicki, published a number of observations of his own and of a farmer with whom be collaborated. Nowicki's work, although important, left a number of problems unsolved. More recent accounts contain little that is new excepting that of Fulmek, who records a few original observations, mainly with regard to the winter generation.

Life History.—For several years past a good deal of attention has been devoted to this insect at Rothamsted, mainly by Mr. J. G. H. Frew, whose results have recently been published.* The main conclusions arrived at from this work are briefly as follows. In Britain the Gout fly passes through two generations in the year—a winter generation and a summer one. The flies commence to appear towards the end of May and deposit their eggs on the leaves of the shoots of spring barley. They are laid singly on the upper side of the leaves, more rarely beneath a leaf, and it is very seldom that a shoot bears more than a single egg. The latter is whitish in colour, elongate cylindrical, with its ventral surface flattened. Being approximately 1 mm. long, it is visible to the unaided eye. After an average of eight days the eggs hatch and the young larvæ migrate *downwards* into the centre of the shoot. Upon reaching the latter they eat their way down one side of the ear and to the internode below it, gnawing a dark brown food groove. After casting its skin twice the larva becomes fully grown: it then turns round within the shoot so that its head is directed upwards. It ascends a short distance and then pupates within the shoot. Pupation takes place in July, and this stage occupies about 36 days. A second generation of flies then occurs, the majority of which appear during August. Their eggs are mainly laid on couch grass: many other wild grasses were specially examined with reference to this point, but none were found to be utilised by the Gout fly. Occasionally eggs are laid on winter

* J. G. H. Frew. On the larval Anatomy of the Gout fly of Barley, etc., *Proc. Zool. Soc. London*, 1923, pp. 783-821: 23 figs.
J. G. H. Frew. On *Chlorops taeniopus* Meig. (the Gout fly of Barley). *Ann. App. Biology*, vol. XI, 1924, pp. 175-219; 2 pls. and 4 figs. With a Statistical Study by "Mathetes," pp. 220-235.

wheat or barley, or upon self-sown wheat or barley. The larvæ pass the whole winter head downwards in the grass shoots until about the end of February. At this time they reverse their position, in the manner already described, and pupate within the shoots early in March. An average of slightly more than two months is spent as pupæ, and the flies commence to appear during the end of May, thus completing the cycle.

Effect on the Plants.—The effect of the presence of the larva in the host-plant, whether the latter be couch grass or barley, is to produce stunting and thickening of the attacked shoot, with a notable increase in the breadth of the leaves and some increase in their thickness. Shoots attacked by the winter larvæ are very thick and short with broad, short and somewhat thickened leaves (Plate I, Fig. 1). No stem is recognisable, it being so stunted that the leaf sheaths all seemingly rise at ground level, while the central leaves are curled in a spiral manner. This condition is evident about the beginning of December, and it is maintained without change or growth until the end of February. After the larva has pupated the attacked shoot dies and soon decays.

The type of distortion produced by the summer attack is much more variable and depends upon the stage of growth of the shoot when attacked (Plate II, Figs. 1, 2 and 3). The typical summer form shows a stem with two or three internodes, terminated by a swollen region consisting of the ear enclosed by its ensheathing leaf from which it never escapes and therefore cannot ripen. The larva, as it migrates downwards, eats away the young grain along one side of the ear and then passes on to the ear-bearing internode and gnaws a groove down one side of this. For practical purposes a shoot of barley attacked by Gout fly may be regarded as totally destroyed. The behaviour of the larva in always migrating downwards has already been referred to. Should the Gout fly deposit an egg upon a leaf whose base comes off from the shoot *below* the base of the ear, the newly-hatched larva cannot reach the ear to feed, and such leaves may be termed "non-critical leaves." In 36 instances dead larvæ were discovered by Frew in the ear-bearing internodes, and in all cases the ear was untouched. In these examples the young larvæ entered the shoots below the ear and, owing to the toughness of and lack of nourishment afforded by the internode, they had perished. If, on the other hand, the egg is laid on a leaf whose base arises from the shoot *above* the base of the ear the ensuing larva, by migrating downwards,

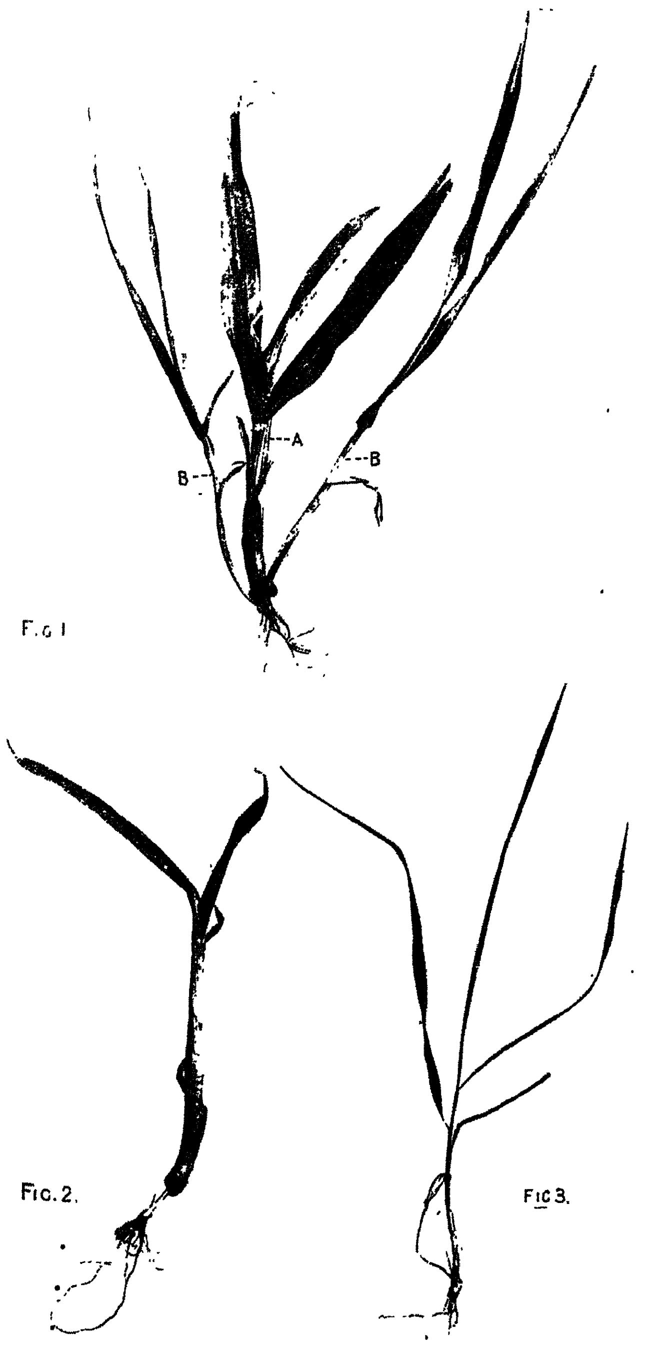

Plate I.

Fig. 1.—A Plant of winter Barley showing the appearance of a shoot A attacked by Gout Fly compared with two normal shoots, B.

Fig. 2.—A shoot of couch grass attacked by the winter larva of *Chlorops taeniopus*.

Fig. 3.—A normal shoot of couch grass during the winter.

PLATE II.

FIG. 1.—The typical form of summer attack on Barley.

FIG. 2.—Ear and Ear-bearing internode from a typical example of Barley attacked by the summer generation of *Chlorops taeniopus.* P the puparium. Pupation has taken place in the food groove, below the ear.

FIG. 3.—Summer damage on Barley resembling the winter form. A the attacked shoot; B, C and D unattacked shoots. D is a normal ear-bearing shoot which has been broken short.

The Ministry is indebted to the Cambridge University Press for the loan of the block of the above illustrations.

reaches the ear: such leaves may, therefore, be designated "critical leaves." A leaf arising from a shoot half way up the ear is to be regarded as a "half critical leaf," since the larva would only be able, at most, to attack the base of the ear. The instincts of the parent fly, however, are far from perfect, and eggs may be laid on any of the above three types of leaves (Plate II, Fig. 4).

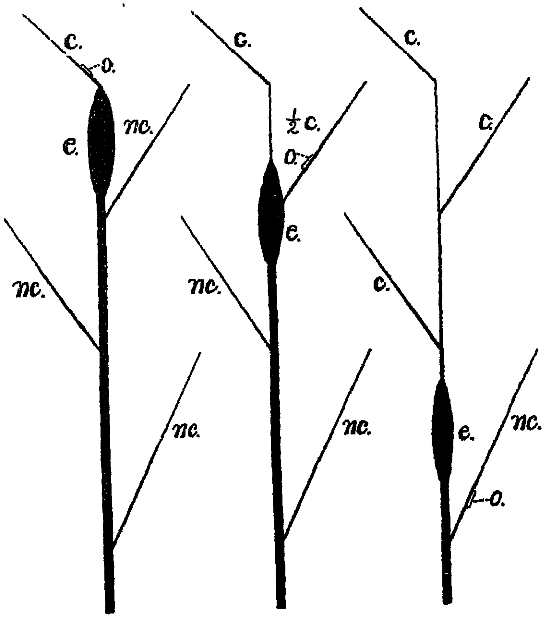

PLATE II.

FIG. 4.—Diagram of Barley Shoots showing from left to right, eggs (o) on (c) Critical Leaf; (½c) Half-critical Leaf, and (nc) Non-critical Leaf.

Effect of Manurial Treatment.—The permanent barley plots on the Hoos Field at Rothamsted* have yielded data which clearly indicate that the summer infestation by Gout fly shows a wide range of intensity according to the kind of manurial treatment adopted. The most probable explanation of this fact is found in the differences exhibited on different plots in the rate of early growth of the stem and ear of the barley. Correlated with this feature is a variation in the number of leaf blades which, at the time of egg-laying by the Gout fly, arise from the shoot above the level of the apex of the ear; or, in other words, a variation in the number of critical and non-

* Observations were also carried out on malting barley plots at Woburn, Dunmow, and Wellingore, but the infestations by Gout fly were too low to draw reliable conclusions from the various plots.

critical leaves. A discussion of this subject from the standpoint of plant physiology is out of place here, but it may be stated, in a few words, that any manures which stimulate the plant so as to force up the ear and ear-bearing internode are likely to have a beneficial effect in reducing infestation. Two years' observations were conducted on the 28 plots of Hoos field, which involved the counting of over 60,000 separate barley shoots and the noting of the numbers infested by the Gout fly in each case.

Both years' observations clearly indicated that superphosphate, farmyard manure or complete minerals* were remarkably constant in bringing about a very low percentage of infestation. With regard to plots treated with other artificial manures, no general conclusions could be arrived at. Untreated (control) plots were heavily infested, while those treated with nitrogenous fertilisers indicated that the latter, in some cases, exercise a beneficial effect, but heavy dressings do not conduce to the reduction of infestation and may increase it through retarding the growth of the ear. The application of nitrogenous fertilisers, in conjunction with either superphosphate or complete minerals, however, proved markedly beneficial in each case.

Early Sowing.—The comparative immunity from attack of early-sown barley has often been noted in the field, and experiments conducted by Frew at Rothamsted have yielded useful data. It was found that infestations are very low for early sowing, while rows sown (in 1923) on 10th April, suffered the maximum of attack. February or early March sowings, however, often cannot be accomplished to advantage in heavy, cold, soils, but the sowing should take place at the earliest possible date with due reference to soil conditions.

Conclusions.—In conclusion it may be said that the Gout fly can be largely controlled by preventive measures and not by remedial efforts. Suitable manuring followed by early sowing is suggested: manuring acquires added importance should the sowing necessarily be late. Experiments at Rothamsted point to the importance of farmyard manure, superphosphate or complete minerals, but the value of these results requires testing under ordinary farming practice and on different soils. The application of nitrogenous fertilisers in order to stimulate an infested crop to outgrow attack is useless: once the Gout fly has attacked the barley no remedy is available.

* Complete minerals means potash, superphosphate, sodium and magnesium sulphates.

THE LEWES WOMEN'S INSTITUTE MARKET.

LADY MONK BRETTON.

THE Women's Institute Market, Lewes, was first held on the 14th December, 1919, and during the succeeding year the sum of £862 6s. 0d. was realised from the sale of vegetables and other produce. Since that time it has continued to grow, until during 1924 the sales amounted to £2,685 17s. 7d. Its value to the surrounding cottagers and smallholders can to some extent be appreciated from these figures.

Scope offered by Local Conditions for a Marketing Scheme.—Lewes itself as a centre is exceptionally favourably situated for such an enterprise. It is well served by railways and other means of communication from the surrounding districts, but, although the centre of an agricultural district, dependent almost entirely on agriculture and its allied industries, it formerly drew its supply of vegetables and other produce very largely from the London and Brighton Markets. Such a practice could scarcely be justified economically, and the establishment of the Women's Institute Market at Lewes must be in the interest of both consumers and producers.

The turnover of such a market must ultimately depend on the consuming capacity of the town unless other neighbouring towns are supplied, and although during the past year the turnover has exceeded by three times the amount sold in 1920, this rate of progress cannot be continued indefinitely. On the other hand, it is probable that the market may tend to draw buyers from such towns as Brighton, Eastbourne, etc. Whatever, however, may be the development of the market in the future, it is plain that it has been, and is, of incalculable value to smallholders and cottagers in enabling them to market their produce which otherwise could not be profitably sold.

Origin and Establishment of the Scheme.—The market developed during the difficult period immediately following the war, the first step towards its formation being taken by Miss Brand, a member of the East Sussex Agricultural Executive Committee, to whom it became apparent, from her service on the Food Production Committee of the county, that much could be done to increase the food supply by inducing villagers to produce more food in their gardens and allotments. It was evident to her that the villagers, cottagers and others were not only willing but anxious to do so, but the difficulty arose of disposing of such

produce after it had been grown, hence Miss Brand, assisted by Miss E. Shiffner of Lewes, inaugurated the Lewes Women's Institute Produce Market. It was found that the old Market Hall of Lewes was not being utilised, and this appeared to be a suitable centre. Arrangements were made, therefore, between the President of the future Women's Institute Market, Lady Monk Bretton, and the Corporation of Lewes for the use of this Market Hall one day each week for a payment of 5s. per week. As the market grew, however, and in order to obviate any possible criticism from tradespeople in the town, an agreement was ultimately made with the Corporation for additional storage room, together with ingress and egress into different streets, for which a payment of £45 per annum, including rates, was made. This arrangement eliminated any possible grievance on the ground that the market did not contribute to the rates of the town, whilst at the same time the rental paid is certainly an economic one having regard to the fact that the premises are only utilised one day each week.

System of Management.—The success of the scheme, especially in its early stages, was undoubtedly due to the fact that the management was entirely voluntary, and it has been the arduous work which has been so willingly contributed by those supporting the Institute Market which has been the chief factor of its success. Miss Brand and Miss E. Shiffner have acted as Controller and Secretary of the Market, and have been aided by Assistant Market Controllers. In addition to these a rota of six sellers from the Women's Institutes chiefly concerned undertake the work each week of selling the produce. In this way the management expenses falling on the market are negligible.

Conditions of Membership.—The market was commenced solely to dispose of the produce of members of the local branches of the Women's Institutes, but at the present time a very considerable amount of produce is taken from others who are not members. Smallholders, cottagers, ex-service men, etc., are all encouraged to send their goods. Producers are not in any way restricted to definite quantities of goods, it being the aim of the market to find an outlet for produce which otherwise could not easily be sold. Again, much of the produce is of a seasonal character, so that it would be somewhat difficult to fix quantities.

Methods of Collection, Delivery and Sale.—During the early years of its formation, much of the produce was voluntarily collected and brought to the market by Miss Brand and others,

but latterly, as the market has grown so considerably, the producers make their own arrangements as to delivery of their goods. Vouchers are sent in with the products, which are checked by the Secretary of the market who returns them to the local secretaries connected with the Women's Institute, together with the proceeds from the sale of goods. The local secretaries then pay the various members of the Institute the amounts due to them once each month, and at the same time return to the producers the vouchers sent in with the goods.

Financial Aspect.—The capital outlay in connection with the establishment of the market amounted only to about £13, which was subscribed by those interested in the success of the scheme. Stalls were lent to assist the enterprise, but the market has since purchased its own. The original capital has now been repaid.

A charge of 1d. in the shilling is made for all produce sold and is the only source of revenue. This has been found to be sufficient to pay all expenses in connection with the market, including the somewhat high rental now paid for the premises. During 1921 the proceeds of sales amounted to £1,176 18s. 3d. In 1922 the sum had risen to £1,567 0s. 2d., and in 1923 it had increased to £1,981 15s. 5d., whilst during the financial year 1924 the sales amounted to £2,685 17s. 7d. The growth of the market, however, is not really represented by the increase in the amounts received for sales, as during those years the price of produce has fallen considerably, so that for a similar turnover to be effected a considerably larger quantity of goods had to be sold than during the time when prices for produce of this kind were so high.

The Assistance of the Women's Institute Market to Small Holders.—Situated near Lewes is the village of Ringmer where a number of smallholders were recently established under the Land Settlement Scheme. A number of these had not received the training and experience of the pre-war market gardener and smallholder, more especially perhaps in connection with the marketing of their produce. Still further, the quantity produced by a number of these smallholders was not sufficiently large to be handled by wholesale dealers, and there is no doubt that but for the Women's Institute Market at Lewes a number of these smallholders would not have been able to dispose of their produce profitably, if at all, so that the success of a number of them is largely attributable to the assistance they have received from the Women's Institute Market.

This is shown by the following statement of amounts remitted to the senders in the Ringmer district:—1921, £147 3s. 2d.; 1922, £304 2s. 11½d.; 1923, £607 1s. 8d.; 1924, £929 2s. 6½d.

Assistance of the Market to Rural Education.—As an instance of the value of the market to rural education, it may be stated that a considerable amount of poultry is sent to the market each week by cottagers and smallholders. It was noticed, however, that some of the birds sent, although of excellent quality, were not prepared in accordance with the views of poultry salesmen and consumers, and did not, therefore, command such a good price as they otherwise would have done. The Controller of the market thereupon approached the Agricultural Education Committee of the County Council, and arrangements were made for courses in the killing, plucking and dressing of poultry for the table, to be given to assist those supplying the market. It has since been recently reported to the Committee that most marked improvement is noticeable as regards the manner in which the poultry are now sent to the market.

The market has undoubtedly enabled a number of consumers to obtain produce at a more reasonable price than they otherwise would have done, and, further, has stimulated in no small degree the local production of vegetables, etc.

A factor, too, of no small importance to the health of the community is that a regular and cheap supply of fresh vegetables and other produce such as is sold by the Lewes Women's Institute Market tends to diminish the growing dependence of the urban population, even in comparatively small towns, on produce which has been canned or bottled and which, although possibly of very high feeding value under certain circumstances, cannot completely replace in the average diet those vital food constituents which are so plentiful in fresh vegetables and fruit.

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THE DOWNY MILDEW OF THE HOP.

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IN 1923, an account was given in this *Journal** of a new fungus disease of cultivated hops (*Pseudoperonospora Humuli* (Miyabe and Takah.) Wils.) which had up to that time been observed in one place only in this country, viz., in the experi-

* Vol. XXX, p. 430.

mental hop garden at Wye College, Kent. The opinion was then expressed that the disease had been introduced into this country, either from Japan or America, along with hop-plants imported for breeding purposes from these countries. There was no direct proof, but the opinion was held for the following reasons :—

(1) The disease in question was first observed in Japan in 1905 and in the United States in 1909, and had not been reported from any place in Europe.

(2) No English specimens of the fungus (a downy mildew) causing the disease existed in our national *herbaria* at Kew and South Kensington, nor were there any records in mycological or agricultural literature of the hop being attacked by a downy mildew here.

(3) Hop roots had been introduced both from America (from 1908 onwards) and Japan (in 1917) into the hop nursery at Wye.

Events which took place during 1924 have thrown an entirely new light on the subject. This Downy Mildew of the hop, or a form of it, appeared in the late summer of 1924 to an epidemic degree in this country, both on wild hops and also in hop gardens and hop nurseries, under circumstances which leave no doubt that the fungus is a native of this country. Experimental evidence (mentioned below) was obtained which makes it very probable that the fungus which has recently attacked the hop plant originated on the nettle. Further, the disease was reported in 1924 on cultivated hops in Germany (Württemberg), although the details of this outbreak have not yet been published.*

While on the one hand it is a matter for satisfaction that the new evidence shows that we have to deal with a native, and not an imported, fungus (particularly to one of the writers, who feared that he had unwittingly introduced from abroad a new disease of the hop), on the other hand the position is perhaps more grave for the commercial hop grower, who is possibly now face to face with outbreaks of this new disease on a large scale.

The present article describes first the characteristics of the fungus, and then the disease it produces on cultivated hops, so that hop growers may be in a position to estimate the seriousness of their position should this new disease sweep the country—an event unfortunately well within the range of

* This information was communicated to the writers last December, in a letter received from Dr. Lang, of the Württembergische Landes-Anstalt für Pflanzenschutz, Hohenheim.

possibility. The sudden and epidemic appearance of the Hop Downy Mildew during the wet autumn of 1924 is then described, and in conclusion, its possible origin is discussed.*

Description and Effect of the Disease.—The hop leaf when attacked by the fungus shows on its upper surface characteristic reddish-brown angular spots (Fig. 3), which are paler on the lower surface. The spots are most frequently situated by the side of the midrib or form little islands bounded by the smaller veins of the leaf. It is only on the lower surface of the leaf that the fungus can be seen. If an affected hop leaf is held up in a good light and rolled over the finger so that the curved lower surface is exposed against a bright horizon, and a pocket magnifying glass is used, tufts of *branched* hair-like growths (*conidiophores*) can easily be seen.† Under the microscope the branches are seen to bear a number of seed-like bodies (summer-spores or *conidia*) (Fig. 1). These summer-spores when ripe, fall off, and being dispersed by wind or rain, or possibly carried by animals or insects, rapidly spread the disease. The summer-spore germinates in a very curious manner (see Fig. 2). It requires water for the process, and this is often present as a film of rain-water or dew on the hop leaf. When the summer-spore is immersed in this, its contents begin to change, a segmentation becomes visible, and finally a number of separate units appear, which escape from the spore case into the water, either singly or in a body, and at once reveal themselves as a number (4 to 7, or more) of motile spores (*zoospores*), each provided with two long, exceedingly fine hairs (*cilia*). The motile spores now swim about with great vigour for a short time (about half an hour); and finally each one comes to rest at some spot on the leaf, loses its swimming-hairs, becomes rounded and puts out a little root-like tube which penetrates the leaf and develops spawn (*mycelium*) within its tissues. Infected in this way, the leaf in about a week shows at each point of infection the characteristic angular spots, on the upper surface, and on the lower surface, branched hair-like growths, bearing a new crop of summer-spores.

The colour of the fungus when producing its masses of summer-spores is almost black, tinged with violet. If the spots are small, the colour is not very evident, but when the

* A full account, giving the scientific details, will appear in the forthcoming issue of the "Annals of Applied Biology"; the present summary is published by permission of the Editor of that Journal.

† In this way the present disease can at once be distinguished from the hop mildew, or mould, a fungus which produces upright *unbranched* stalks, bearing chains of spores (see Fig. 2, *Jour. Min. Agric.*, XXVIII, 152 (1921)). The two diseases may occur on the same hop leaf or hop cone.

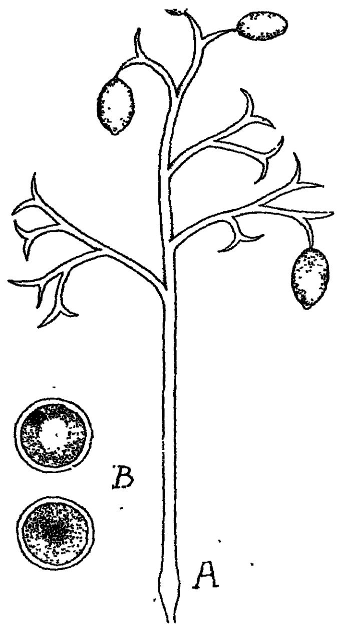


FIG 1.—(A) Branched fructification bearing summer-spores.
(B) Two resting-spores taken from an infected leaf.
(Both magnified 2,500 times.)

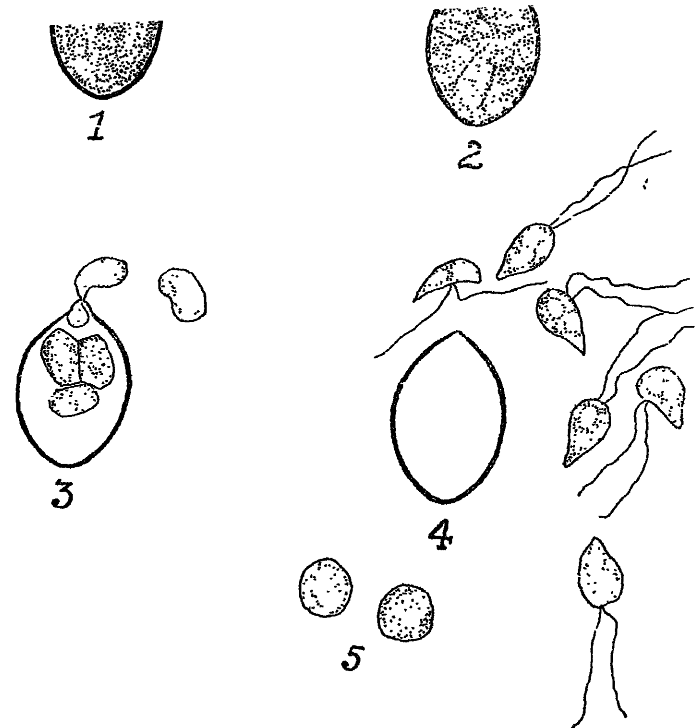


FIG. 2.—Germination of a summer-spore taking place in a film of moisture. 1. A ripe summer-spore. 2. Segmentation of contents visible. 3. Separate units have developed which are beginning to emerge. 4. These, having developed swimming-hairs, move about rapidly in the water. 5. After a short period
lose their

disease is "on the run," which happens in warm, wet, "muggy" weather, the fungus invades the leaf rapidly, the separate spots coalesce and large, brown, irregularly-shaped patches are formed, covered (on the under surface of the leaf) with a conspicuous, somewhat matted growth of a violet-blackish colour.

The Downy Mildew attacks also the hop cones, when they are ripening, and may entirely destroy them. The *bracteoles* of the hop cone are often infected first and these turn brown and wither under the attack, while the rows of bracts remain unaffected and green, thus giving a striped appearance to the hops (see Fig. 4). Ultimately the whole cone may turn brown and more or less wither. If the "petals" of affected cones are pulled apart, the Downy Mildew will be seen in the form of a more or less scattered nearly black growth extending over the inner surface of the petal.* This blackish growth consists of the branched *conidiophores* of the fungus (described above).

Later in the season the fungus forms, within the tissue of the affected leaves, thick-walled resting spores (*oospores*), often in large numbers. It is believed that these resting spores, falling to the ground in the autumn with the leaves, remain alive until the following spring and, germinating then, infect the new hop leaves and thus perpetuate the disease from season to season.

Injury Caused by the Disease.—The following observations are based on a study of the disease as it has occurred in the experimental hop garden at Wye during the past five years.

The injury caused to the hop leaves may perhaps be regarded as negligible, as the presence of the scattered angular spots does not appreciably affect the health of the leaf. Occasionally, however, the mildew may occur in more or less continuous patches extending along the margin of the leaf. which may then turn brown and shrivel up to some extent: it is doubtful, however, even in such cases whether, from the economic point of view, any damage is done.

As soon as the disease begins to attack the cones, however, it becomes a danger of the first magnitude. In 1922 the hop cones of only a few hills were affected, and the number of cones rendered unfit to pick was small; in 1923 the cones on a larger

* This growth of the fungus is clearly visible only in wet or damp weather; in dry, sunny weather the brown, withering cones show no signs of the fungus under a pocket lens.

Photo.] [*Dr. H. Wormwald.*

FIG. 3.—Hop Leaf showing the angular spots caused by the Downy Mildew (*Pseudoperonospora Humuli*). (Nat. size.)

Photo.] [*Dr. H. Wormwald.*

FIG. 4.—Hop-cones attacked by Downy Mildew; the Bracteoles are

Photo.] [*Dr. H. Wormwald.*

FIG. 5.—A stunted, diseased, spike-like Basal Shoot (May, 1923) caused by the Hop Downy Mildew. (About ½ nat. size.)

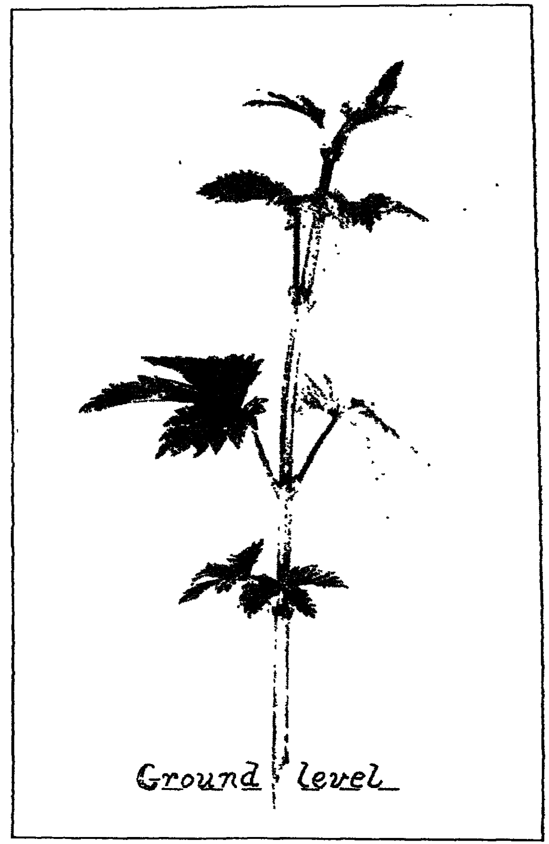


Photo.] [*Dr. H. Wormwald.*

FIG. 6.—A healthy Basal Shoot from the same plant (May, 1923). (About ½ nat. size.)

number of plants were attacked and, in a few cases, from one-quarter to one-half the crop was destroyed; in 1924 several hundreds of plants showed the disease in their cones, and a considerable number had either the whole or three-quarters of the crop rendered unfit to pick. It is obvious, therefore, that if the present disease becomes widespread, it may constitute a new menace to hop growing in this country.

In 1923 the disease appeared in a form not previously noticed. Some of the hills produced, during both spring and summer, in addition to the normal shoots, one or more thickened shoots of a spike-like form, from a few inches to a foot or over in length. These did not climb, but remained arrested in growth, producing small, curled, somewhat brittle leaves, arising close together (see Figs. 5 and 6). On the leaves of these shoots, as well as on the surface of the stem, the Downy Mildew produced its fructifications (bearing the summer-spores) in dense, more or less continuous masses, often blackening the entire lower surface of the leaf. Besides these distorted, spike-like shoots arising from the hill, similar diseased growths occurred during the summer, terminating otherwise healthy bines, sometimes when these had reached the breast wire, or a little over (5 or 6 ft. from the ground), or more rarely when the bines had reached or passed the top wire (12 to 14 ft. from the ground) (Fig. 7). Frequently, also, the lateral shoots became attacked and were converted by the disease into small, stiff, spiky growths, which remained permanently arrested (see Fig. 8).

Although the development of the fungus in the spike-like shoots which arise in the hills in spring and early summer has not yet been followed, the fact that spawn (*mycelium*) of the fungus has been found in the inner tissues of the stem and that fructifications may emerge from blister-like places on the stem suggests the possibility that the mycelium of this Downy Mildew may hibernate in the crown of the hill, or in its buds, and then in the next season grow up inside the stem of some of the new shoots, distorting them and producing fructifications on the small, curled leaves. Should it be proved that the fungus remains permanently in the crown of a hop plant once affected, hop growers will be faced with a disease likely to appear year after year in the hop garden.* If the distorted

* In a disease of beets caused by a downy mildew (*Peronospora Schachtii*), allied to that occurring on the hop, the spawn (*mycelium*) of the fungus is known to live in the crown of the root from one season to the next.

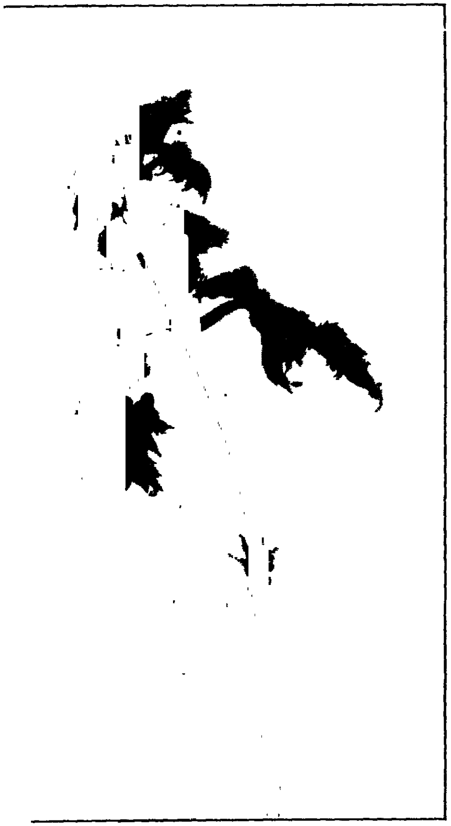
shoots arising out of the hill are not due to the presence of internal spawn, it must be supposed that they arise as the result of a mass infection in the spring by germinating winter-spores. It is difficult to believe, however, that such external infection could bring about the cessation of growth of the young shoots. A mass infection by summer-spores of the tips of the bines, and also of the young laterals must be supposed to account for the production of the spikes found far above the ground, since it appears unlikely that the spawn could travel up the stem such a distance without interfering with the normal growth.

The economic damage in the hop garden at Wye caused to the bines themselves by the distortion noted above, has been inconsiderable; the harm has been that each season masses of summer-spores have been produced on the spikes, leading inevitably to the appearance of the disease on the hop cones.

Control Measures.—The leaves, hops and shoots became affected to the extent described above, notwithstanding that certain measures were taken against the disease. It will be well to describe these, as there is unfortunately the possibility that in the future some such measures may be required in other hop gardens. It may be noted here also that as the steps taken failed to prevent the recurrence of the disease, it is obvious that should the fungus become established in commercial hop gardens, direct measures, *i.e.*, spraying with a fungicide, will be necessary.

In 1923 all spike-like shoots coming up in the hills were cut off, as soon as they were noticed, below the soil-level. Throughout the summer, as soon as the Downy Mildew was noticed on the leaves of any hop plant in the garden, all its leaves, whether infected or not, were removed to a height of 5 or 6 ft., and burnt. The same treatment was given to the next plant on either side, for fear that it might have become infected. As soon as the hops had been picked, all the bines were cut down, carted off and burnt.

In 1924 the control measures were commenced earlier; the Downy Mildew being first noticed in one part of the garden in May, the lower leaves of *all* the plants throughout the garden were removed to a height of one and a half feet from the ground and in a second operation, carried out a few weeks later, to a height of 5 to 6 ft. from the ground. A continuous search was made for the spike-like shoots throughout the growing season, and whenever these were found, they were at once



[*Dr. H. Wormwald.*

—Deformed and spike-like tip of the Bine of
l Hop. Growth has been arrested at 5 ft.
ound. ($\frac{4}{5}$ths nat. size.)

Photo.] [*Dr. H. Wormwald.*

FIG. 8.—Part of the Bine of a Cultivated Hop showing a pair of normally developed lateral shoots (above), and two pairs which

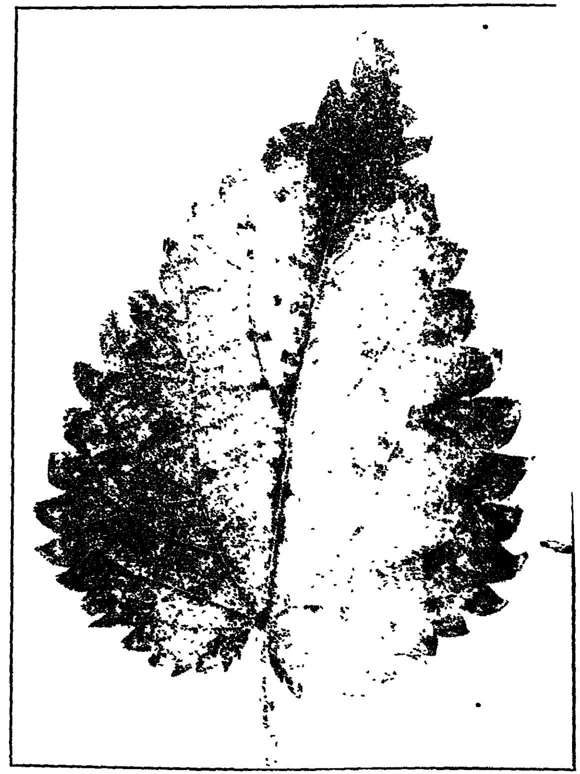


Photo.] [*Mr. W. M. Ware.*

FIG. 9.—Nettle Leaf (*Urtica dioica*) showing the

removed; if several such shoots came up in a hill, that plant was grubbed up and burnt. It was found that the removal of the spike-like shoots in 1923 did not, in many cases, prevent their recurrence in the same hill in 1924. In 1924 no less than 425, out of the 6,250 plants growing in the experimental hop garden, *i.e.*, 6.8 per cent., produced diseased spike-like shoots in the hill. The plants attacked were of the most diverse origin, and included the following:—several German and American cultivated varieties; the wild hop of Europe (*Humulus Lupulus*) from which all our cultivated varieties have been obtained, and the wild hop of America (*H. americanus* var. *neo-mexicanus*), and hybrid seedlings raised from the above. The varieties which have proved most susceptible to the Downy Mildew, particularly as regards the hop cones, are the American and Canadian hops, and hybrids raised from them.

With regard to the weather conditions under which the disease spreads in the hop garden, it is certain that wet weather favours the attack by the fungus on the hop cones. In continued wet weather, such as was experienced in 1924, a crop of green, nearly ripe hops may be turned brown within a few days and rendered worthless for the market. On the other hand, the fungus can continue to produce its summer-spores on the leaves of actively growing hop plants, even during the hottest summer weather, as was observed during July and August, 1923.

(*To be concluded.*)

THE PROBLEMS FACING SOUTH-WESTERN BROCCOLI GROWERS.

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THE broccoli producers in the Penzance district are faced with several serious problems at the present time, which must be faced or the growers will be pushed out of the markets by competitors. The importance of the industry can be gauged by the fact that about 15,000 tons of broccoli are sent away annually. The difficulties can be grouped into two main sections, (*a*) matters concerning the packing, grading and marketing of the produce, and (*b*) growing problems.

Packing.—The writer does not intend to deal in this article with packing, grading and marketing at any length, beyond pointing out how necessary it is for the grower to adapt himself to present-day conditions. The packages in general use in Cornwall are obsolete and have the result of prejudicing the produce irrespective of its quality. It is becoming more and more a recognised fact that the non-returnable has so many advantages over the returnable package, that the latter will have to go. Back freightage charges, market tolls, unmanageableness and damaged contents, are some of the arguments to be used against the Cornish wickers and the Cornish nets. A certain number of non-returnable wooden crates are being used in the district, but these are not so suitable or so well made as the two-dozen French Roscoff crate.

Again, growers would get better returns, and the standard of the industry would be raised, if growers were to pack their own broccoli instead of selling fields piecemeal. The grading and trimming of the heads is essential, as the variation in the contents of our Cornish packages has lowered their prestige in the markets of this country. The grower has everything to lose by packing discoloured, broken, and various-sized curds in the same container. Unnecessary freightage is often paid owing to the inclusion of much superfluous foliage.

Cultural Problems.—From an occasional observation of the Penzance district broccoli fields, it becomes obvious to the most casual observer that in many of these fields a large proportion of the plants are costing money to produce and giving little or no return. Owing to the bad strains still grown many of the heads formed are quite unsaleable, and of the remainder many are low grade or poor quality broccoli.

Mr. Gray, in a Gulval Experimental Plot Report in 1922, observed that many of the plants were not broccoli, but hybrid kales and cabbages. This has been brought about by the home saving of seed, accompanied in most cases by an absence of selection. Where, however, a little trouble is taken the grower is rewarded by a much more even and remunerative crop. Several growers, however, through foresight and care in seed saving, have good strains of the Penzance varieties.

The broccoli growers generally describe the successional cuttings and varieties taking them in chronological order in the following terms—" protectors," " Penzance first earlies," " Penzance second earlies," " lates," and " dead lates."

Although our Penzance types are generally described as rough and of poor colour, it is only fair to point out to people not familiar with the local climatic conditions, that the local types are better able to withstand the weather than the majority of the imported white high quality curded broccoli. The susceptibility to disease of the early imported sorts is very great, particularly those falling in the protector group.

The following figures, prepared by the Head Gardener at Gulval Experimental Plot, show the susceptibility of a few of the earlier varieties to leaf spot. Taking 0 per cent. as clean—

	Per cent. infection.
Snow's Superb Early White	90
French Varieties	85
Winter Beauty	60
Superb Early White	45
Early Snowdrift	40
Winter Mammoth	15
Early Feltham	10
Matthew's Early Penzance	5
Earliest White St. Laud	4
Gulval Cross B (Early Penzance X Powers Winter Beauty)	4

The only practicable course open to the grower is to produce varieties combining the resistance of the Penzance varieties with high quality curd.

This suggestion has been worked upon at Gulval Experimental Plot by Messrs. Glavin and Gray, and results are now coming to hand. We have been successful in breeding the constitution of the Penzance sorts with the high quality curd of some of the varieties mentioned above, our main aim being to suppress the yellow curd of the Penzance but to retain its hardy constitution.

Leaf spot alone is referred to above; this is not the only trouble growers are faced with, as leaf dropping is a serious

complaint throughout the district. The latter trouble is undoubtedly brought about by a combination of varietal and cultural factors.

Gulval Experimental Plot.—The Cornwall County Council have for years past carried out trials of broccoli at the Gulval Experimental Plot with the object of saving individual experimenting and the consequent loss to the individual.

The trial work at Gulval can be divided into three groups—

(*a*) The testing of standard and new varieties.

(*b*) Hybridisation and selection.

(*c*) Manurial trials conducted under field conditions in the district.

The Testing of Standard and New Varieties.—Large variety experiments were laid down in 1921, in one season alone 56 varieties being tested. Fully one-half of these proved to be useless for the Penzance industry. Of the remainder many did not come to perfection at the proper season, many stocks were mixed and many appeared to be synonymous with others grown under different names. The most promising varieties were grown on during the following seasons with the addition of any outstanding new varieties.

The following list of varieties shows the most promising of those sent for trial:—

Variety.		*eason.*
Winter Beauty	...	Beginning Oct.—November.
Winter Mammoth	...	October—November.
Late Protecting	...	October—December.
Mammoth ...	...	Mid. November—End December.
December ...	...	October—December.
Winter Mammoth	...	December—January.
Early White ...	...	January—February.
Lily White ...	...	December—February.
Giant Winter ...	...	December.
Early Feltham	...	Beginning Jan.—Mid. Feb.
Superb Early White	...	Beginning Jan.—Mid. Feb.
Mid. Feltham	...	Mid. January—February.
Earliest White St. Laud...		January.
First Early White	...	January—February.
Early Snowdrift	...	January—February.
Snow White ...	...	February—March.
Favourite Late	...	March—April.

Experience has shown that in a hot dry season the later plantings perfect a larger percentage of marketable heads than the earlier plantings. The trials have also shown that varieties failing in one season may do well the following season and vice-versa, and that maturity is influenced by many factors.

Roscoff Broccoli.—Two strains of this French broccoli have been grown during the present winter, and in view of the abnormal season and the poor results obtained in the district, the growers' strain of Roscoff has stood out in a wonderful way. The stock has been very uniform, the plants have been strong and retain their foliage, producing a fine white curd of good quality, whilst the main-stem has been thick and sturdy. Many growers in the district have given favourable opinions on the growers' form of Roscoff, and it seems that this may supply us with the white high-class curded broccoli so necessary for wooden crate trade in the Penzance district.

Hybridisation and Selection.—Many of the bad strains grown in the Penzance area are due to the fact that the usual growers' method of seed saving is to leave a small patch of plants in the corner or centre of a field for seed purposes. Even if these had been selected and were a good strain, the risk of being crossed with a poor or inferior form is very great. To show how far pollen is carried, the case may be instanced where broccoli pollen was collected on one of the Cornish lighthouses many miles from any flowering brassicas. This necessitates all the work at Gulval being performed under screens, owing to the risk of infection. Several crosses have been made at Gulval, the aim in all cases being to combine the hardy constitution of the Penzance varieties with the white high quality curd of the better sorts. Some of the hybrids have shown whiter but not ideal curds, and these hybrids, although giving good promise, have been again crossed with the idea of getting a still whiter centre. In most cases the crosses were made both ways.

The protector as seed parent gives slightly earlier heads than when Early Penzance is the seed, and the protector the pollen parent. The crosses showed increased vigour and more protection than the types.

The following are details of the crosses made at the Gulval Experimental Plot:—

The first cross made was Early Protecting X Early Penzance (we will term this Gulval Cross A). The cross was made both ways.

The second cross was made with Early Penzance X Winter Beauty (Gulval Cross B).

Crops from these first crosses showed that the season of cross A was from early December to January and filled a gap that often exists between protectors and Penzance earlies.

In the case of cross B the hybrid particularly demonstrated its resistance to leaf spot, whilst the heads realised 1s. per dozen more than the heads of local varieties.

With a view to increasing still further the quality of the curd (that is trying to eliminate the dominant yellowing influence of the Early Penzance) two further crosses were made. Gulval Cross A X December (Gulval Cross C), and in the same season Winter Mammoth X Gulval Cross A gave Gulval Cross D. In the present season we have under trial nine selected and selfed forms of A, in addition to the more recent crosses C and D. The cross B has been grown on, selected, and selfed. We are also growing the French Roscoff strains alongside for comparison. Some of the Gulval hybrids have been sent to Wisley for inclusion in the Royal Horticultural Society's broccoli trials this year. Seed from these hybrids will be raised in a district where there is little risk of infection from foreign pollen. It will be seen from the above that the work so far has been confined to the earlier sorts. This was intentional, as undoubtedly the worst section grown is the early section. Some of the selected forms also show a tendency to fill a gap, and to provide a continuity of supply. Although it will take time to fix the strains thoroughly, enough has been done to show that the work should be of great value to the Penzance growers.

Manurial Experiments.—On general lines the manurial experiments have shown the following :—

Lime.—The growth on the limed plot was much more pronounced than on the unlimed portion, and leaf dropping did not assume a serious aspect. Stem maggot damage was also reduced where an application of lime had been given. Plants growing on the limed area seemed more healthy and vigorous, although perhaps maturity was slightly delayed.

Potassic and Phosphatic Dressings.—The healthy growth of the kainit and the kainit and superphosphate plots was very marked, and the plants showed a much greater resistance to leaf spot.

Nitrogenous Dressings.—It is questionable whether late summer or autumn dressings of nitrate of soda or sulphate of ammonia are economical. The broccoli in the Penzance district is usually grown on the residual dressing from the early potato crop, and this provides ample growth-making material. In a season like 1923-24 the sappy growth on the plots receiving a nitrogenous dressing suffered more than the plants on the untreated portions.

MARCH ON THE FARM.

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Seasonal Operations.—Should the farm be favoured with more than the usual portion of the proverbially valuable March dust, it is more than likely that operations will still be in arrears at the end of the month. On the stronger soils in south and east Derbyshire, team work has been impossible since the end of November, and at this date (16th February) many farmers have been unable to begin carting out manure on to meadow land. Grass that has carried cattle during the past winter is in a badly trodden and poached condition, and the mild weather has produced green growth which has been eaten in preference to the usual rough fare. For both reasons, it might be wise to expect of such fields rather less productivity during the coming season; and perhaps this is an instance where even pasture land might be given a little complete fertiliser, to assist in the re-forming of the sward and to induce an earlier spring growth.

If the winter of 1921-22 were any guide, spring oats might be expected not to give very satisfactory results this year. In the season 1922, potatoes and root crops yielded well after the preceding mild wet winter. The British climate, however, obeys no precedent and seed potatoes are now very expensive; but potatoes certainly have an advantage in that they can be sprouted and planted rather late, should earlier planting be impossible owing to prolonged cleaning operations. Marrow-stem kale, which in recent years has begun to be substituted for swedes and cabbage, is worth special consideration. Not only can it be drilled in April or May and singled out like a root crop; but it can be sown in a small seed bed in March and transplanted therefrom at a later date, if cleaning should delay the drilling operation. This crop should, however, receive the same liberal manuring and nitrogenous top-dressing as good farmers give to mangolds or cabbages.

Owing to the constant humidity and absence of frost, heavy land will most likely work very unkindly, if it is allowed to lie unmoved until the time for cleaning in April or May. Should opportunity occur, and especially while night frosts are about, the land might be cross-ploughed or run back. After the middle of March, however, any ploughing done should only be shallow. The deeper movement, which may later be neces-

sary for cleaning purposes, should be performed with tine implements, of which perhaps the best is the spring tine harrow.

Regarding the sowing of spring corn, it is a very common error to roll the soil down heavily soon after drilling. On heavy land this operation, performed while the soil is still moist at or near the surface, is not only superfluous but injurious. It is also most unlikely that winter corn will require rolling during this month; harrowing to promote aeration of the saddened tilth will perhaps be more necessary than usual.

Seeds Mixtures.—In prescribing mixtures of grass and clover seed for one-year leys, most authorities now include both alsike and trefoil. Trefoil is practically immune to the eelworm form of clover sickness, to which both alsike and the red clovers are susceptible; and should these fail it is capable of producing a heavy growth from a small quantity of seed. Alsike is not often injured to any extent by the stem rot fungus, and it will thrive on soils containing too little lime for the red clover. Trefoil and alsike are, therefore, included for safety. The main points on which opinions differ are:—

(1) Whether Italian or perennial rye grass should be preferred;

(2) The respective merits of common red clover and single-cut cow-grass; and

(3) The quantity of seed necessary per acre.

The following two prescriptions represent opposing views concerning the first two points. Having regard to the reputations of the four plants concerned, it may cause some surprise to see Mixture A indicated as for grazing and B for hay; yet that differentiation appears to be fully in accordance with the results of recent field trials.

A.—For Grazing.

	lb. per acre
Italian rye grass	12
Broad red clover	5
Alsike	2
Trefoil	1
Total	20

B.—For Mowing.

	lb. per acre
Perennial rye grass ...	18
Single-cut cow-grass ...	5
Alsike	2
Trefoil	1
	26

Mixture A is very widely sown in England, and several seed firms adopt it as a standard prescription. Italian rye grass and broad red clover are undoubtedly earlier in growth than the corresponding components in Mixture B. Where winter and

early spring grazing is of special value, as where a flock of sheep is kept, Mixture A would probably be preferable. For mowing, however, many trials have proved the superiority of mixtures of the B type, in the northern parts of the kingdom at any rate.

Regarding the quantity of seed, 20 lb. per acre, some farmers consider this insufficient, except perhaps on an ideal tilth and very clean land. Accordingly, they sow heavier seedings of the complete mixture, or they add more rye grass. The latter practice often results in the hay crop containing very little red clover, owing to the excess of rye grass having suppressed it. In experiments at the Harper Adams College in the years 1908, 1909 and 1910, a mixture composed of only 5½ lb. of Italian rye grass and 8½ lb. of clovers gave heavier crops than another containing nearly three times these quantities. At Craibstone, Aberdeenshire, 3½ lb. of red clover and 1 lb. of alsike suffice to produce an abundance of clover in the hay; but here the soil is of light nature and the rye grass used is the "perennial" variety. But assuming, on the results of the Aberystwyth investigations,* that the soil casualties are 60 per cent. of the viable seeds sown, Mixture A should still produce a "take" of about 50 seedlings per square foot, about half of these being clovers. It would seem, therefore, that 20 lb. of good seed, properly sown on a reasonably good seed bed, should be enough to produce a full plant. Where experience proves that more seed is required, it is possible that shortage of lime or clover sickness (eelworm type) is present. As a rule an application of basic slag at the time of seeding favours the establishment of the clover plant.

Mixture B represents the Cockle Park view. Professor Gilchrist there found by experiment that, in mixtures containing red clovers, perennial rye grass gave a heavier and more clovery crop of hay than Italian rye grass. Later he found that single-cut cow-grass gave better results than common (or broad) red clover. This finding with regard to the rye grasses has been confirmed at Craibstone; and more recently Mr. Johnstone-Wallace has found that in north Yorkshire the Cockle Park type of mixture is superior for weight of hay, even where the crop is cut twice in the year.

Custom and Science.—Lady Day being the time when farms change hands, March is a busy month in valuation matters. Here custom and science are often at variance, the former pre-

* Methods of Covering Grass and Clover Seeds, this *Journal*, March, 1923, p. 1125.

vailing. Custom is regarded as the simple and "practical" basis of compensation; it is definite and admits of no argument. For example, the custom of limiting the residual effect of lime to three years is simple and definite; but frequently it is also inequitable. Lime applied ten years ago may proclaim its continued effect in marked contrast with an unlimed strip in the same field; perhaps no measurable improvement may have been visible during the first three years after the application; yet custom rules that the outgoer who applied the lime reaped the benefit of his outlay during the first three years.

In connection with the manurial residues of feeding stuffs, the custom of basing compensation on the cost price of the foods still survives in some tenancies. By this custom, the residual value of maize meal is the same as that of soya meal bought at the same price per ton, regardless of present day knowledge of plant nutrition, the composition of foods, and the utilisation of food constituents by the animal. Where Voelcker and Hall's tables are adopted, their adjustment to the circumstances of a particular case by the application of scientific reasoning would probably involve controversy and arbitration; hence custom is made to rule the use of the tables. Conventional interpretation may, however, impose upon the incomer expenditure for which he cannot hope to receive a proper return. The manurial residues for which he is made to pay may have been wasted by the outgoer, who perhaps used too little litter, or allowed the manure to become leached in the yard, or the liquid manure to run down the ditch. In law it is the landlord who is liable to pay compensation for manurial residues; hence in certain cases a deduction for loss of liquid manure might appear to be a hardship, if there was no liquid manure tank on the farm.

Regarding compensation for cake consumed by cattle on pasture, it has yet to be shown by experiment that the value of manurial residues of feeding stuffs so consumed is commensurate with their unit price. In pasture land, nitrogen can be accumulated free of cost, and rarely does the application of nitrogenous manure produce a profitable result on old turf. Undoubtedly greater improvement can usually be effected at less cost by the use of suitable artificial manures than by cake feeding.

Stock Breeding.—In oat cultivation, black varieties are preferred for poor soils and bleak conditions; on somewhat better land a yellow variety such as Golden Rain or Goldfinder may

be suitable; but for good moist soils where the highest yields are possible, white sorts such as Record, Yielder and Abundance are recommended. Subject to limitations of climate and depth of soil, the farmer can, of course, improve his land and thereby render it fit to grow a variety better than that for which it was previously suitable; but the yield and nature of the resulting crop is determined as much by the climatic and soil factors as by the quality and pedigree of the sample of seed sown.

In stock breeding the parent animals can be regarded as the seed producers. As with corn, breed and type must be chosen with due regard to the limitations of the environment; and, likewise, the size and appearance of the matured offspring depend as much on environment—rearing, feeding and management—as on the quality and pedigree of the parents.

Some breeders who have bought or had the use of pedigree bulls have been disappointed on finding that the progeny appeared to be little if any better than common stock. It is a mistake to suppose that pedigree can make up for defective rearing and unimproved grass land. Undoubtedly well-bred cattle respond better to good conditions than do animals of nondescript breeding; but it is well known that the size and conformation of a beast is greatly influenced by its treatment during calfhood, and by the quality of the pasture, etc., which it receives during the first three years of its life. Some of the most prized features in the mature animal—the neat head, short legs, broad deep chest and well-sprung rib—are dependent on proper nutrition during the growing period. Dairy cattle of deep milking strain require good rearing and must not be caused to bear the stress of pregnancy and lactation at too early an age.

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MANURES FOR MARCH.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Basic Slag and Grass Land.—A recent article by Professor Somerville in *The Times* newspaper has once more directed the attention of farmers to the great possibilities of improving grass land by the use of basic slag. This question has been repeatedly discussed for many years, and the evidence has frequently been brought before the farming community.

It cannot be said, however, that farmers yet make as full use as they might of basic slag. Various reasons have been put forward, such as want of capital and lack of interest, but there is one that for the past three years has been engaging the attention of the Rothamsted Experimental Station. It is that basic slag does not always act beneficially on grass land; there are instances where it fails, and the task of the experimenters has been to discover why. Broadly speaking, two main reasons have been found:—

1. The slags of the present day are not entirely similar to those of the pre-war days when the classical work at Cockle Park and elsewhere was carried out. Basic slag is not, in short, one substance in the sense that nitrate of soda, sulphate of ammonia and superphosphate are single substances, but it is a group of materials which differ considerably among themselves. Thus if a farmer purchases a 30 per cent. superphosphate from one maker of repute, the article is as nearly as can be identical with 30 per cent. superphosphate from any other maker of equal standing. But if he purchases two 25 per cent. slags from different makers, the substances may be quite different in their chemical nature and their agricultural value.

2. There are important soil conditions in which slag readily acts, particularly on the Boulder Clay soils where but little white clover occurs. Large areas of land of this type might usefully be treated. But there are other soil conditions in which slag appears to be less potent.

Two causes of soil failure are already known, and methods of dealing with them have been worked out:—

(*a*) The land may be too sour, in which case it requires a dressing of lime before the slag can act.

(*b*) There may be insufficient potash; this may be supplied by addition of kainit, 20 per cent. potash salts, etc.

Besides these there are numerous instances of second-class grass land on which some slags act much better than others; the Rothamsted land is of this kind, and the staff at Rothamsted has for some time past been endeavouring to discover the differences between the effective slags and those of less value.

Basic slags fall into two great groups; those in the making of which fluorspar was used, and those to which no fluorspar has been added. Field experience shows that the fluorspar slags are often less effective than the others: chemical examination shows that they contain some of their phosphate in the form of fluorapatite, a substance which is of little, if any,

value to plants. The slags free from fluorspar, on the other hand, contain some, if not all, of their phosphate in the form of silico-phosphate, which is of very considerable value to plants. Mr. Page has devised a method for ascertaining the amount of fluorine in slags, from which can be calculated the maximum value for the quantity of fluorapatite present. Some of his results are:—

Slag No.		(1) *Total Phosphate per cent.*	(2) *Citric Solubility per cent.*	(3) *Fluorapatite (little value).*	(4) *Silico and other phosphates (much value).*
1	...	42.5	77.2	1.4	41.1
2	...	29.2	91.0	Nil	29.2
3	...	28.9	16.4	26.9	2.0
4	...	25.1	98.4	Nil	25.1
5	...	24.3	30.0	22.0	2.3
6	...	21.1	27.7	12.3	8.8
7	...	19.8	70.9	Nil	19.8
8	...	18.0	81.3	1.3	16.7
9	...	17.8	37.7	17.1	0.7
10	...	17.2	78.7	1.4	15.7

(1) *i.e.*, total phosphoric oxide (P_2O_5) multiplied by 2.18 to convert into the equivalent quantity of tricalcic phosphate ($Ca_3(PO_4)_2$).

(2) *i.e.*, percentage of the total phosphoric oxide (P_2O_5) which is soluble in the official 2 per cent. citric acid solution.

(3) Calculated from fluorine present, assuming all to be in form of fluorapatite.

(4) The remaining phosphate.

The slags are arranged in order of total phosphate and therefore approximately in order of price. Reference to the last column shows, however, that they differ considerably in their content of effective phosphates. Thus, slags 2 and 3 are rated equal by the ordinary analysis and might be offered at the same price by a merchant acting in perfectly good faith and honesty. Field tests show that No. 3 is less effective than No. 2. Mr. Page's method shows that it contains most of its phosphorus in the non-effective form of fluorapatite, while No. 2 contains all its phosphate in the effective forms. The citric solubility test in this instance would have shown the difference, but its indications are not always clear.

Present chemical methods do not, however, enable slags to be completely characterised and there are still differences in effectiveness which cannot be explained. This is well shown in the sheep grazing trials at Rothamsted, in which, over a period of four years, slags Nos. 1, 6, 7 and 8 were compared. The excess gains in live weight of sheep expressed in lb. per

acre of the slagged over the unmanured plots in the different seasons have been :—

	1921	1922	1923	1924	*Total Benefit in 4 years. lb. live weight per acre increase over unmanured plot.*
Slag No. 7 ...	50	19	62	18	149
" " 8 ...	Nil	Nil	Nil	30	30
" " 6 ...	Nil	Nil	15	Nil	23
" " 1 ...	Nil	21	7	Nil	28

It is obvious that No. 7 is by far the most effective of these slags, being better even than No. 1, which was known to act well on other soils, but no chemical test so far tried would show this superiority to a prospective purchaser. At the time we obtained the slag neither the makers nor ourselves knew or even suspected that it would prove any better than No. 8 or as good as No. 1, nor can we yet explain why it should be so. It seems clear that somewhere in its history this slag received some treatment which greatly enhanced its agricultural value, and which, if it could be repeated on other slags, might have a similar effect. A possible clue has been furnished by the manufacturers, and an observation has been made in the chemical laboratory which may furnish the solution of a very attractive problem.

A third factor which may be important has been discovered in the past season by Dr. Brenchley and Mr. Page. Some of the slags examined were found to contain substances harmful to the plant. This does not, of course, mean that they actually damaged the crop: what happened was that in these particular slags the beneficial effect of the phosphate present was in part counteracted and the full value not obtained. All these problems are being followed up, and the co-operation of the slag makers is being secured through the Permanent Basic Slag Committee of the Ministry of Agriculture. In the meantime farmers who have applied slag to their grass and obtained unsatisfactory results are requested to communicate the facts to the Director of the Rothamsted Experimental Station in order that the fullest information on this subject may be obtained. Failure to derive benefit from a slag should not cause a farmer to give up the idea of improving his grass land, but rather to ascertain how the failure came about so that he can remedy it. The Rothamsted work is providing the means of doing this.

Sulphate of Ammonia and Soil Acidity.—A letter recently appeared in *The Times* newspaper suggesting that sulphate of ammonia is an unsafe fertiliser owing to an effect it may produce

in causing the soil to become sour. Sulphate of ammonia is sometimes called an acid fertiliser, and in point of fact many of the samples do contain a small quantity of free acid. This, however, is insufficient to produce any significant effect in the soil; its real disadvantage is that it rots the bags and tends to make the fertiliser somewhat lumpy. A neutral sulphate of ammonia is now on the market and is preferable whenever it can be obtained because of its finer condition and its greater ease in drilling.

The Woburn experiments have shown that sulphate of ammonia produces an acid effect in the soil when it is used continuously, year after year, without any intervening dressings of lime. At Woburn the effect took many years to show itself; it was first seen on the barley land after some 20 years of continuous manuring with sulphate of ammonia alone. So unusual a course of treatment would probably never occur in actual farm practice. The only occasions when the writer has seen ill effects from the use of sulphate of ammonia have been when it is applied to barley in which clover seeds are sown where the land is deficient in lime. In such cases the clover suffers, sometimes rather seriously.

The proper way of securing the maximum efficiency of sulphate of ammonia is to apply lime or ground limestone periodically in the rotation. This should be done in any case whenever the soil requires it.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Animal Nutrition Institute, Cambridge University.

The Use of Gram as a Feeding Stuff.—Quantities of gram appear to be reaching the English markets, and since this grain appears to be rather unfamiliar to the ordinary farmer a few notes on its feeding qualities may be of value.

Gram belongs to the pulse family, and, as its analysis shows, closely resembles beans and peas in composition and digestibility.

Percentaye Composition.

	Drv Matter	Protein	Oil	N. free Extract	Fibre	Ash.	Dig. Prot.	Dig. Oil	Dig.N. free Extract	Dig. Fibre	N.Ratio	S.E.
Beans...	85·7	25·4	1·5	48·5	7·1	3·2	19·3	1·2	44·1	4·1	1·2	65·8
Peas ...	86·0	22·5	1·6	53·7	5·4	2·8	16·9	1·0	49·9	2·5	1·3	69·0
Gram ...	89·0	23·4	1·1	54·3	5·1	5·1	14·7	0·7	50·5	2·9	1·3	71·0

The seeds are slightly smaller than peas, the outside coat varying in colour from olive green or yellow to light brown and chocolate brown, the light brown and chocolate brown colours predominating. They are of a peculiar but easily recognised shape, resembling in general outline a chick's head. As their analysis indicates they can be used in all cases where peas and beans are used, and form an efficient substitute for these two grains. Although not widely known to farmers, gram is used freely in proprietary foods and mixtures, both for cattle and poultry feeding. There is no reason, therefore, why farmers and poultry keepers should hesitate to employ this grain for stock or poultry feeding, if purchasable at a price approximating to that ruling for peas or beans. As far as poultry keepers are concerned, gram may be fed either as grain in the grain mixture, or as a meal in the mash.

The Economical Feeding of Roots.—The use of roots for stock feeding dates from the period when it was realised that the replacement of a bare fallow by a root crop was economically sound. The employment of a root crop in a rotation enabled the farmer to carry out the usual tillages associated with bare fallowing while enabling him at the same time to grow a crop useful for stock feeding. The benefit was cumulative, in that the farmer was able to keep more stock on a given area, with the resultant benefit to the land of the accumulated fertility due to the extra dung returned to the land. The root crop is, however, very susceptible to climatic conditions, resulting in variable seasonal yields. For this reason, a farmer who grows a large area of roots generally purchases store stock for feeding off the roots, and in periods when stores are dear feeds roots lavishly. Two or three years ago the writer endeavoured to ascertain the ideal amount of roots that should be fed to a beast. Inquiries showed that practical experience differed considerably in different parts of the country. In Norfolk, a root-producing county par excellence, as much as 1½ cwt. of roots a day were fed, in the Midlands 35 lb. a day was considered the best, in the south of England 70 lb. of roots was considered the economical limit, whereas in the west of England no roots at all were fed. A well-known Organiser of Agricultural Education in the south-west of England also states that not only are roots not necessary for the dairy cow, but that he has obtained a bigger milk yield in certain herds by dispensing with roots altogether. It is a common observation that the feeding value of roots varies considerably in different districts. Even in Norfolk and Suffolk the

Description.	Price per Qr. s. d.	Price per Qr. lb.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	—	—	14/8	14 13	0 16	13 17	71·6	3/10	2·05
Barley, British Feeding	—	—	12/3	12 5	0 12	11 13	71	3/3	1·74
" Canadian :—									
No. 3 Western	44/3	400	12/5	12 8	0 12	11 16	71	3/4	1·78
" 4 "	43/6	"	12/2	12 3	0 12	11 11	71	3/3	1·74
" American	43/6	"	12/2	12 3	0 12	11 11	71	3/3	1·74
" Danubian	43/6	"	12/2	12 3	0 12	11 11	71	3/3	1·74
" Karachi	43/6	"	12/2	12 3	0 12	11 11	71	3/3	1·74
Oats, English, White	—	—	10/8	10 13	0 13	10 0	59·5	3/4	1·78
" " Black and Grey	—	—	9/9	9 15†	0 13	9 2	59·5	3/1	1·65
" Scotch White	—	—	11/4	11 7	0 13	10 14	59·5	3/7	1·92
" Canadian :—									
No. 2 Western	36/3	320	12/8	12 13	0 13	12 0	59·5	4/–	2·14
" 3 "	35/–	"	12/3	12 5	0 13	11 12	59·5	3/11	2·10
Argentine	29/6	"	10/4	10 7	0 13	9 14	59·5	3/3	1·74
Maize, Argentine	48/–	480	11/2	11 3	0 13	10 10	81	2/7	1·38
Beans, English Winter	—	—	11/3	11 5	1 12	9 13	67	2/11	1·56
" Chinese "	—	—	11/9	11 15	1 12	10 3	67	3/–	1·61
Peas, English Maple	—	—	12/11	12 18	1 8	11 10	69	3/4	1·78
" Japanese	—	—	23/9	23 15†	1 8	22 7	69	6/6	3·48
Rye, Homegrown	—	—	11/4	11 7	0 16	10 11	71·6	2/11	1·56
Dari, Egyptian	—	—	11/3	11 5	0 15	10 10	75·2	2/10	1.52
" Persian	—	—	12/6	12 10	0 15	11 15	75·2	3/2	1·70
Millers' Offals :—									
Bran, British	—	—	—	8 15	1 7	7 8	45	3/3	1·74
" Broad	—	—	—	10 0	1 7	8 13	45	3/10	2·05
Middlings—									
Fine Imported	—	—	—	10 17	1 2	9 15	72	2/8	1·43
Coarse, British	—	—	—	9 7	1 2	8 5	64	2/7	1·38
Pollards, Imported	—	—	—	8 15	1 7	7 8	60	2/6	1·34
Meal, Barley	—	—	—	13 10	0 12	12 18	71	3/8	1·96
" Maize	—	—	—	11 12	0 13	10 19	81	2/8	1·43
" " South African	—	—	—	11 5†	0 13	10 12	81	2/7	1·38
" " Germ	—	—	—	10 15	0 19	9 16	85·3	2/4	1·25
" " Gluten Feed	—	—	—	10 15	1 7	9 8	75·6	2/4	1·25
" Locust Bean	—	—	—	9 15	0 9	9 6	71·4	2/7	1·38
" Bean	—	—	—	13 15	1 12	12 3	67	3/8	1·96
" Fish	—	—	—	21 0	4 7	16 13	53	6/3	3·35
Linseed	—	—	—	25 2	1 11	23 11	119	3/11	2·10
" Cake, English 12% Oil	—	—	—	14 0	1 18	12 2	74	3/3	1·74
" " 10% Oil	—	—	—	13 10	1 18	11 12	74	3/2	1·70
" " 9% Oil	—	—	—	13 5	1 18	11 7	74	3/1	1·65
Cottonseed Cake, English 5¼% Oil	—	—	—	8 5	1 15	6 10	42	3/1	1·65
" " Egyptian 5¼% Oil	—	—	—	8 2	1 15	6 7	42	3/–	1·61
Decorticated Cotton Seed Meal 7% Oil	—	—	—	12 5	2 14	9 11	74	2/7	1·38
Ground Nut Cake 7% Oil	—	—	—	11 0*	1 16	9 4	56·8	3/3	1·74
Palm Kernel Cake 6% Oil	—	—	—	9 5	1 3	8 2	75	2/2	1·16
" " Meal 2% Oil	—	—	—	8 7	1 4	7 3	71·3	2/–	1·07
Feeding Treacle	—	—	—	7 10	0 8	7 2	51	2/9	1·47
Brewers' Grains :—									
Dried Ale	—	—	—	10 5	1 4	9 1	49	3/8	1·96
" Porter	—	—	—	9 15	1 4	8 11	49	3/6	1·87
Wet Ale	—	—	—	1 12	0 9	1 3	15	1/6	0·80
" Porter	—	—	—	1 8	0 9	0 19	15	1/3	0·67
Malt Culms	—	—	—	8 10†	1 14	6 16	43	3/2	1·70

* At Hull. † At Liverpool.

feeding value varies. Thus the writer has been informed of an instance of bullocks attaining a condition on one farm on roots and straw alone that on another farm necessitated an addition of 5 lb. of cake a day to the ration to maintain bullocks in a like condition of fatness. It is curious, therefore, that no work has been carried out in England on two very important points, *i.e.*, why roots vary in feeding value from farm to farm, and the best quantity of roots to include in a ration.

The latter point, *i.e.*, the best quantity of roots to be fed in a ration, has been investigated in Sweden by Professor Nils Hansson, as far as dairy cows are concerned.*

Professor Nils Hansson carried out a very careful investigation on four lots of cows, fed under precisely similar conditions, and on the same mixture of foods. The only variable was the amount of roots fed, and the rations were adjusted so that the same total nutritive material was fed in all cases. The light roots lot were given roughly 32 lb. of swedes per head per day, the medium roots lot 68 lb. a day, and the heavy roots lot 96 lb. a day. As the result of this investigation, Professor Nils Hansson came to the following conclusions: (1) Roots help the efficiency of a ration because they are a juicy fodder; (2) Small rations of roots are better utilised than medium rations of roots, and medium rations of roots are better utilised than heavy rations of roots. According to Prof. Hansson's observation, the depression of the efficiency of the ration is most marked when rations contain more than 60 lb. of roots per head. The deductions that we should draw from the above experiments are (1) about 30-35 lb. of roots per head is the best quantity and (2) 60 lb. per head is the maximum quantity of roots that should be fed to dairy cows if the efficiency of the ration is to be considered. The Midland practice of only feeding 35 lb. a day where roots are not plentiful, and the eastern counties and southern counties practice of feeding 60 lb. of roots a day where roots are plentiful obtains interesting corroboration from this scientific experiment.

* For detailed treatment of this work see "The Optimum Quantity of Roots for High-yielding Cows," by Prof. James Wilson, M.A., B.Sc. Jour. Dept. of Lands and Agriculture, Dublin, Vol. XXIV, No. 3.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat - - - - - -	1·38	2 15	71·6	9 5	0 16	10 1
Oats - - - - - -	1·38	2 7	59·5	7 14	0 13	8 7
Barley - - - - - -	1·38	2 7	71·0	9 3	0 12	9 15
Potatoes - - - - -	1·38	2 7	18·)	2. 6	0 4	2 10
Swedes - - - - -	1·38	2 7	7·0	0 18	0 2	1 0
Mangolds - - - -	1·38	2 7	6·0	0 15	0 3	0 18
Beans - - - -	1·38	2 7	67.0	8 13	1 12	10 5
Milk - - - - - -			17.1			
Good Meadow Hay - -	1·96	3 8	31·0	5 14	0 14	6 8
Good Oat Straw - - -	1·96	3 8	17·0	3 2	0 7	3 9
Good Clover Hay - -	1·96	3 8	32·0	5 17	1 0	6 17
Vetch and Oat Silage - -	1·65	3 1	14·0	2 3	0 7	2 10
Barley Straw -	1·96	3 8	19·5	3 11	0 6	3 17
Wheat Straw - - -	1·96	3 8	11·0	2 0	0 4	2 4
Bean Straw - - - -	1·96	3 8	19·0	3 10	0 9	3 19

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending February 4th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 0	13.17	12.17	13 15	17. 9
" " Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13. 9*	13. 9*	13. 9*	13. 9*	(N)13.0
" " " neutral (N. 21.1 per cent.)	14.12*	14.12*	14.12*	14.12*	(N)13.10
French Kainit (Pot. 20 per cent.)	3.0	2.15	...	2.12	2. 7
" " (Pot. 14 per cent.)	...	2.10	2. 7	2. 7	3. 5
Potash Salts (Pot. 30 per cent.) ...	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.)	...	..	2.12	2.10	2. 6
Muriate of Potash (Pot. 50 per cent.) ...	...	7. 5	7. 5	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	...	11.15	11. 7	11. 5	4. 8
Basic Slag (T.P. 30 per cent.)	3. 2§	...	2.12§	2.12§	1. 9
" " (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
" " (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
" " (T.P. 24 per cent.) ...	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.12	3. 8	1.11
" (S.P. 30 per cent.) ...	3. 7	3. 5	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9.10	8.15	8..7	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	7. 0†	7. 7†	6. 5	6. 7†	...
Fish Guano (N. 7½-8¼, T.P. 16-20 per cent.)	...	...	13. 0	...	...
" " (N. 9, T.P. 10 per cent.) ..	...	...	...	13. 0	...
Burnt Lump Lime	1. 8	1.17	1.18	2. 2§	...
Ground Lime	1.14	2. 7	2. 8	1.16§	...
Ground Limestone	1. 1	...	1. 4	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

New Approved Immune Varieties of Potatoes.

THE following varieties of potatoes have been added to the Ministry's list of varieties approved as immune from Wart Disease as the result of the 1924 trials (see also p. 1085). One variety ("Southesk") completed the tests in 1923, but has only recently been named and placed on the market.

Second Early Varieties:—

Balvaird.

Sprout - pink.
Tuber - kidney; skin white; flesh white; eyes shallow.
Haulm - compact, dwarf, upright; leaflets grey-green, large, broad, dull, soft appearance; stems slight pink coloration at the base only; wings straight.
Flowers - white.

Lord Scone.

Sprout - pink.
Tuber - kidney; skin white; flesh pale yellow; eyes shallow.
Haulm - dwarf, spreading, weak; leaflets dark grey-green, soft appearance, glossy; stems slight pink coloration; wings straight.
Flowers - white.

Oran Beauty.

Sprout - pink.
Tuber - round; skin white; flesh pale yellow; eyes shallow.
Haulm - dwarf, prone; leaflets medium green, large, broad; stem pink coloration at base; wings crinkled.
Flowers - white, rare.

Sefton Wonder.

Sprout - pink.
Tuber - round, large; eyes medium depth; skin russetty; flesh white.
Haulm - tall, upright, vigorous; leaves dark green and glossy.
Flowers - white: buds usually drop without opening.

(Note: With the exception of its russetty skin, this variety is similar to "Great Scot.")

Late or Main Crop Varieties:—

Aberdonian (The).

Sprout - pink.
Tuber - round; skin white; flesh pale yellow; eyes medium.
Haulm - compact, bushy; leaflets dark green, very small, short, narrow, erect; leaf close; stems green, thin, numerous; wings straight.
Flowers - blue heliotrope tipped white.

Arran Consul

Sprout - pink.
Tuber - round to oval, irregular in shape; skin white; flesh pale lemon; eyes shallow; stem end usually indented.

Haulm - open, upright to spreading, moderately vigorous; leaflets dull, light grey-green, narrow, soft; leaf very open; few secondary leaflets; stem slight bronzing; wings straight.

Flowers - white, borne on long stalks, not numerous; buds dark green; anthers yellow, irregularly formed.

Cambria.

Sprout - pink.

Tuber - round; skin white, pink blush at heel end; flesh pale yellow; eyes medium, pink.

Haulm - open, upright, moderately vigorous; leaflets medium green, large, broad, drooping; stem green; wings crinkled.

Flowers - white, small.

Claymore.

Sprout - pink.

Tuber - round; skin white; flesh pale lemon; eyes shallow.

Haulm - compact, upright, vigorous; leaflets yellowish-green, corrugated, dull; stems green; wings crinkled.

Flowers - white, numerous, long styles.

Corona.

Sprout - pink.

Tuber - round to oval; skin white; flesh very pale yellow; eyes medium.

Haulm - upright, vigorous; leaflets yellow-green, drooping, corrugated; leaf close; stem much bronzed mottling; wings crinkled.

Flowers - white, rare.

Earl of Essex.

Sprout - purple.

Tuber - round, irregular; skin white mottled purple; flesh white; eyes medium.

Haulm - upright, vigorous.

Flowers - purple.

Gigantic.

Sprout - pink.

Tuber - kidney; skin white; flesh pale lemon; eyes shallow.

Haulm - open, upright; moderately vigorous; leaflets dull grey-green, small, erect habit; stems green; wings slightly crinkled; leaf open.

Flowers - rare, white, with pale heliotrope colouring on under-surface, sepals long.

Glenmaid.

Sprout - pink.

Tuber - oval; skin white; flesh white; eyes shallow.

Haulm - open, upright, tall, vigorous; leaflets dark green, long, narrow, hard, glossy; stem mottled purple pronounced in axils; wings markedly crinkled and hairy.

Flowers - white, moderately numerous.

Incomer.

Sprout - pink.

Tuber - broad oval; skin white; flesh white; eyes very shallow.

Haulm - tall, upright and spreading; stem mottled red purple, strong, branching freely below ground; wings wavy at the tops; leaf close; leaflets medium green, dull and cupped; secondary leaflets numerous and often pointed upwards.

Flowers - buds green to dull red purple; flower stalks short; flower not noted.

Pink Pearl.

Sprout - pink.

Tuber - kidney; skin deep pink; flesh deep yellow; eyes shallow.

Haulm - open, tall upright; leaflets grey-green, small, erect, corrugated, dull; stem general reddish-purple bronzing, especially in the axils and extending to the petioles and mid-ribs; wings crinkled.

Flowers - white, very rare, buds pink, sepals long.

Purple Champion.

Sprout - deep rose.

Tuber - round; eyes very deep; skin pale blue purple; flesh white.

Haulm - tall, upright; stem purple; leaves dark green, small.

Flowers - deep mauve, tipped white.

Southesk.

Sprout - purple.

Tuber - round, skin white; flesh pale lemon; eyes shallow, slight purple blush at heel end of tuber and in the eyes.

Haulm - upright, tall; leaflets grey-green, small, dull, crinkled; stems strong, bronzed; wings straight, serrated towards the apices of the stems.

Flowers - white, small, numerous.

White Arran Victory.

Sprout - purple.

Tuber - round; skin white mottled purple; flesh very pale lemon; eyes medium.

Haulm - tall, upright strong, with reddish colour; leaves dark green, repend.

Flowers - cream.

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Lectures by Rothamsted Staff.

DURING the forthcoming season it would be possible for members of the staff of this Institution whose names are appended to give a few lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Agricultural Societies, Farm Workers' Organisations, etc., dealing with the experiments being carried on at this Station in regard to the subjects mentioned on the attached sheet.

As much notice as possible beforehand is requested, and an endeavour will be made to fall in with the convenience of the Societies as to dates and precise scope of lectures.

No fee will be charged for the services of the lecturer, but Associations would be expected to defray travelling expenses and to make all necessary arrangements for the lecture.

All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

1. Manuring, etc., for Farm Crops ..	Mr. H. V. Garner, B.A.
Root Crops and Potatoes.	
Cereals.	
Grass Land.	
The Rotation.	
Management of Farmyard Manure.	
Chalking and Liming.	
2. Soil Micro-Organisms (Bacteria, Protozoa, etc.)	
Lucerne Inoculation	Mr. H. G. Thornton, B.A.
Life in the Soil.	Mr. D. W. Cutler, M.A.
3. Agricultural Botany	Dr. Winifred E. Brenchley, F.L.S.
Weeds of Arable and Grass Land.	
4. Agricultural Chemistry	Mr. H. J. Page, B.Sc.
The Principles of Manuring.	
The Chemistry of Crop Production.	
5. Soil Physics	Dr. B. A. Keen, F.Inst.P.
Soil Cultivations	Mr. E. M. Crowther, M.Sc.
Soil Acidity and Liming	Mr. W. B. Haines, B.Sc.
6. Insecticides and Fungicides.	
Control of Wart Disease of Potatoes ...	Mr. W. A. Roach, B.Sc.
Insecticides and Fungicides ...	Mr. F. Tattersfield, B.Sc. Mr. C. T. Gimingham, F.I.C.
7. Entomology.	
Insect Pests	Dr. A. D. Imms, M.A.
Horticultural, Market Garden and Orchard Pests	Dr. J. Davidson.
Bee Keeping	Mr. D. M. T. Morland, B.A.
8. Mycology	Dr. W. B. Brierley.
Potato Diseases (Wart, Virus, etc.).	
Plant Diseases; their causes and control.	
Soil Fungi and Plant Growth.	

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Facilities for Agricultural Lecturers, Etc.

THE Rothamsted Experimental Station is anxious to extend to all agricultural lecturers and organisers facilities for the use of its library, which is now one of the best agricultural libraries in the Empire. Lecturers and organisers are therefore invited to visit the library and consult the volumes; this can be done any day between the hours of 9 a.m. and 6 p.m. by applying to the Librarian. Arrangements have also been made whereby copies of papers and extracts from papers and books can be made by a competent typist and sent to any who are unable to visit the Institution themselves. Charges for typist's work are strictly moderate and can be obtained on application to the Librarian.

Instruction in Milk Recording.

ARRANGEMENTS have been made by the authorities of the Midland Agricultural College to hold a course of instruction in Milk Recording, from 20th April to 9th May, 1925, provided that a sufficient number of students apply for admission. A syllabus showing full particulars of the course may be obtained on application to the Principal, Midland Agricultural College, Sutton Bonington, Loughborough. The course includes lectures on milk—its nature and composition, bacteria and their relation to milk, testing of milk, and the principles and practice of milk recording; and practical work on actual milk recording of a comprehensive character, including food records, cost of foods, and cost of food per gallon of milk. The tuition fee will be £3 3s. Board may be obtained at the Sutton Bonington Hostel (30s. per week). The registration fee for the period is 5s.

Preference will be given to students who are either already milk recorders under the Ministry's scheme or who intend to apply for such posts. It is not possible to give any indication as to what vacancies for milk recorders may arise, nor can any guarantee be given that students will in fact obtain employment as milk recorders. The names of successful students will, however, be circulated by the Ministry to all Milk Recording Societies in order that preference may be given by societies to these students when vacancies occur. The appointments carry salaries ranging usually from £150 to £250 per annum, and they afford to young agriculturists an excellent opportunity of acquiring a practical knowledge of dairy farming, often of the best type, as carried out on a variety of farms.

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Farm Workers' Minimum Wages.

THE Agricultural Wages Board held meetings on 27th January, 10th February and 24th February and considered notifications from various Agricultural Wages Committees of their resolutions fixing minimum rates of wages. The necessary Orders carrying out the Committees' decisions were made in respect of the following 29 areas. The rates shown below are in each case those fixed for male workers of 21 years of age and over.

Buckinghamshire.—From 9 Feb. to 31 Oct., 1925. 30s. for 50 hr. in summer (first Monday in March to the last Sunday in October) and 48 hr. in winter (remainder of the year). Overtime at 9d. per hr. on weekdays and 11d. per hr. on Sundays.

Cheshire.—From 23 Feb. to 31 Oct., 1925. 35s. for 54 hr.; overtime at 9d. per hr.

Derbyshire.—From 16 Feb. to 15 Dec., 1925. 8d. per hr., with a guaranteed week of 54 hr. for whole-time workers. Overtime rates for Sunday work 10d. per hr.

Durham.—From 9 Feb. to 13 May, 1925. Horsemen: 32s. for 50 hr., and any additional time spent in attention to horses, with an extra payment for such workers who are householders of 7s. per week, and in the case of workers who are not householders, and who are not boarded and lodged by the employer, an extra 1s. 10½d. per wk. Stockmen and shepherds: for customary hours—(*a*) householders 43s. per wk.; (*b*) workers who are not householders, and are not boarded and lodged 37s. 10½d. per wk.; (*c*) workers who are boarded and lodged 36s.; other adult male workers 32s. for 50 hr. Overtime rate for all adult workers 9d. per hr.

Gloucestershire.—From 9 Feb. to 11 Oct., 1925. Head carters: 34s. 6d. for 58 hr. in summer (first Monday in March to the last Sunday in October); 36s. for 60 hr. in winter (remainder of the year). Head shepherds or head stockmen: 36s. for 60 hr. Under carters: 32s. 6d. for 54 hr. in summer; 34s. 6d. for 57 hr. in winter. Under shepherds or under stockmen: 34s. 6d. for 57 hr. Other adult male workers: 30s. for 50 hr. Overtime, 9d. per hr., in certain cases 11d. on Sundays.

Hampshire.—From 9 Feb. to 11 Oct., 1925. 30s. for 51 hr. in summer (first Monday in March to first Sunday in November); 48 hr. in winter (remainder of the year).

Hertfordshire.—From 9 Feb. 31s. (7¾d. per hr.) for 48 hr. Overtime (which the Committee has defined only as time worked on the weekly half-holiday) at time-and-a-quarter.

Kent.—From 2 March for 12 months. Horsemen, stockmen and shepherds: 33s. for 52 hr., with 8d. per hour for all employment in excess of 52 hr. per wk., but not exceeding 60 hr. per wk. occupied by customary duties. Overtime: 10d. per hour for all employment in excess of 60 hr. and for all work on weekdays in excess of 52 hr. occupied by other than customary duties. Sunday employment on other than customary duties 1s. per hr. Other males: 32s. 6d. per week of 52 hr. in summer (1 March to 31 Oct.) and 48 hr. in winter (remainder of the year). Overtime: 10d. per hr. on weekdays, 1s. per hr. on Sundays.

Leicester and Rutland.—From 16 Feb. to 31 Oct., 1925. The Committee have fixed separate minimum rates for each administrative county: Leicester 34s. for 54 hr., Rutland 32s. 6d. for 54 hr.; overtime for each county at 9d. per hr. on weekdays and 11d. per hr. on Sundays.

Lincolnshire:—

Holland Division.—From 16 Feb. to 4 Apr., 1925. 36s. for 48 hr. with extra payment to cattlemen and shepherds of 4s. per wk., and to horsemen, 10s. per wk. to cover time spent on customary duties in connection with the care of animals. Overtime 9d. per hr. on weekdays (except Saturdays), 10½d. per hr. on Saturdays and 1s. 1½d. per hr. on Sundays.

Kesteven and Lindsey Divisions.—From 16 Feb. for twelve calendar months. 32s. for 52 hr. in summer (first Monday in March to the day before the first Monday in November) and 48 hours in

winter (remainder of the year), with an addition for waggoners of 7s. per wk., shepherds, 5s. per wk., and stockmen 6s. per wk. to cover the time spent on customary duties in connection with the care of animals. Overtime at 9½d. per hr. on weekdays and 11½d. per hr. on Sundays.

Northamptonshire and Soke of Peterborough.—From 2 March to the last Sunday in Oct., 1925. Male workers 30s. for 50 hr. in summer (first Monday in March until last Sunday in Oct.) and 48 hr. in winter (remainder of the year). Overtime 9d. per hr. on weekdays, 11d. per hr. on Sundays.

Nottinghamshire.—From 21 Feb. to 31 Oct., 1925. 32s. for 50 hr. with overtime at 9½d. per hr. on weekdays and 11½d. per hr. on Sundays.

Oxfordshire.—From 16 Feb. to 31 Oct., 1925. 30s. for 50 hr. in summer (first Monday in March to the last Saturday in October) and 48 hr. in winter (remainder of the year), with overtime at 9d. per hr. on weekdays and 11d. per hr. on Sundays.

Shropshire.—From 9 Feb., 1925. 31s. 6d. for 54 hr., and for time in excess of 54 and less than 57 hours, 7d. per hr.

Staffordshire.—From 9 Feb. to 27 June, 1925. 31s. 6d. for 54 hr., overtime 9d. per hr.

Surrey.—From 9 Feb., 1925. Skilled male workers (*i.e.*, stockmen, shepherds or horsemen) 38s. 8d. for 60 hr. Other regular workers 32s. 3d. for 50 hr. Casual workers 7¾d. per hr. Overtime 10d. per hr. on weekdays, 11½d. on Sundays.

Sussex.—From 2 March to last Sunday in October, 1925. Horsemen, cowmen or shepherds 35s. for 58 hr. Other male workers of 21 years and over 30s. for 52 hr. in summer (first Monday in March to last Sunday in Oct.) and 48 hr. in winter (remainder of year).

Warwickshire.—From 9 Feb. to 31 Oct., 1925. 30s. for 48 hr. in winter (first Monday in Nov. to the last Saturday in Feb.), and 50 hr. in summer (remainder of the year). Overtime 9d. per hr. on weekdays and 11d. on Sundays.

Wiltshire.—From 9 Feb. to 11 Oct., 1925. 30s. for 50 hr. Overtime 8d. per hr.

Yorkshire:—

North Riding.—From 16 Feb. to 1 Nov., 1925. 33s. for 52½ hr. in summer (first Monday in March to the last Saturday in Oct.) and 48 hr. in winter (remainder of the year), with payment for any extra time spent in attention to cattle, sheep or horses, in the case of workers boarded and lodged by the employer, at 4d. per hr. and in the case of other workers at 8d. per hr.

East Riding.—From 2 March to 23 Nov., 1925. Adult male workers who are boarded and lodged, viz.—foremen 32s., waggoners 28s., beastmen and shepherds 29s., for 52½ hr. in summer (first Monday in March to last Saturday in Oct.) and 48 hr. in winter (remainder of the year), with an additional 12 hr. on weekdays and 3 hr. on Sundays in attendance to cattle and horses. Other male workers 34s. for 52½ hr. in summer (first Monday in March to last Saturday in Oct.) and 48 hr. in winter (remainder of the year) with overtime at 10¾d. per hr. on week days and 1s. 1d. per hr. on Sundays.

West Riding.—From 2 March to 23 Nov., 1925. Horsemen, beastmen and shepherds (not living in) 42s. for 52½ hr. in summer (first Monday in March to last Saturday in Oct.) and 48 hr. in winter (remainder of year), with an additional 12 hr. on weekdays and 3 hr. on Sundays occupied by stable work or attention to stock. Adult male workers who are boarded and lodged—foremen (not hinds) 33s., waggoners 30s., beastmen and shepherds 32s., for 52½ hr. in summer (first Monday in March to last Saturday in Oct.) and 48 hr. in winter (remainder of year), with an additional 12 hr. on weekdays and 3 hr. on Sundays occupied by stable work or attention to stock. Other male workers 36s. for 52½ hr. in summer (first Monday in March to last Sunday in Oct.) and 48 hr. in winter (remainder of year). Overtime rates for all classes 11d. per hr. on weekdays and 1s. per hr. on Sundays.

Denbigh and Flint.—From 16 Feb. for twelve calendar months. Team-men, cattlemen, cowmen, shepherds and bailiffs, 37s. for 61 hr.; other adult male workers 30s. 6d. for 50 hr. Overtime 9d. per hr.

Merioneth and Montgomery.—From 16 Feb. to 1 May, 1925. Stockmen, teamsters, carters and shepherds 34s. for 60 hr. Other adult male workers 31s. for 54 hr.

Pembroke and Cardigan.—From 2 March for 3 months. Male workers 30s. for 50 hr. in winter (first Monday in Nov. to last Sunday in Feb.) and 54 hr. in summer (remainder of the year). Overtime 8d. per hr. on weekdays, 9d. per hr. for first 3 hours on Sundays and 10½d. per hr. for subsequent employment.

Radnor and Brecon.—From 9 Feb. to 2 Apr., 1925. 31s. for 50 hr. in winter (1 Nov. to 31 Jan.), and 52 hr. in summer (remainder of the year).

The above Orders include minimum rates for male workers under 21 in all cases, and for female workers in all cases except Derby, Denbigh and Flint, and Merioneth and Montgomery.

In the case of Gloucester, Hampshire and Hertfordshire the overtime rates came into force on 16 February, and in Wiltshire on 23 February, whilst in the North Riding of Yorkshire and Radnor and Brecon the overtime rates cannot become operative until the Committees for those areas have confirmed their proposed Orders defining the employment to rank as overtime employment.

The Board has also made orders with regard to minimum rates for female workers in Dorset, Suffolk and Anglesey and Carnarvon, and in respect of overtime rates in Dorset (male workers only), Hereford, Worcestershire, Anglesey and Carnarvon.

The Board has also made an Order for rates to operate in Cambs. and Ely as from 1 March, when the existing rates are due to expire. (The Order, which is to run up to 31 Oct., 1925, continues the rates for horsemen, cowmen and shepherds at 37s. per week of the hours necessary for the performance of the customary duties of such workers; but in the case of other male workers aged 21 years and over the minimum rate of 30s. will be payable from 1 March in respect of a week of 51 hours instead of 48 as at present.)

Advantages of Milk Recording.

IN the January issue of this *Journal* (pp. 931-4) a short article was published dealing with the advantages of milk recording. It is regretted that through an oversight no acknowledgment was made of the fact that a part of this article consisted of an extract from an article contributed by Capt. A. G. Soames to the Year Book of the Bucks. Milk Recording Society. The Ministry now hastens to rectify the error and to record its indebtedness to Capt. Soames' excellent article.

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Foot-and-Mouth Disease.—There was no further spread of disease from the outbreak which occurred at Stoke Bardolph on the 12th January last, and all restrictions in respect of the area surrounding the infected premises have now been withdrawn.

On 26th January, two outbreaks were confirmed at Ovingdean, East Sussex, which were followed by others at Rottingdean on the 27th January, and Iford, Lewes, on the 29th January. The usual restrictions were imposed over an area within 15 miles of the first outbreaks. This has since been materially reduced.

Disease reappeared at Yardley Hastings, Northants, on 14th February, the premises involved being those in which disease existed in December las The usual restrictions were imposed in this case also, and there h been no further extension of disease.

On 19th February disease was confirmed on two premises in the same occupation at Castle Bromwich, Birmingham, and these outbreaks have been followed by three further outbreaks in the same vicinity, namely, at Sheldon on 21st February, at Warley on 23rd February, and at Yardley on 24th February.

The existence of disease was also confirmed at Necton, Swaffham, Norfolk, on 19th February, the premises involved being those on which an outbreak occurred on December, 1924.

The usual restrictions have been applied to the districts surrounding the sources of these new outbreaks.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Holman, R. M., and *Robbins, W. W.*—A Textbook of General Botany for Colleges and Universities. (597 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 20s. net. [58.]

Lambert, T.—Bone Products and Manures: A Treatise on the Manufacture of Fat, Glue, Animal Charcoal, Size, Gelatin and Manures. Third Edition, revised and enlarged by H. B. Stocks. (292 pp.) London: Scott, Greenwood & Son, 1925, 10s. 6d. net. [664.3; 664.6; 63.16.]

Newton, C. M.—C. M. Newton's Self-Contained Farm Account Book. Adapted for Income Tax Purposes and Farmers Making their own Valuations. (50 pp.) Northampton: J. Stevenson Holt, 1924, 5s. net. [657.]

Bledisloe, Lord.—The Economic Value of Agricultural Science. (16 pp.) London: P. S. King & Son, 1924, 3d. [37(01).]

Field Crops.

Howard, A.—Crop Production in India: A Critical Survey of its Problems. (200 pp.) London: Oxford University Press, 1924, 10s. 6d. net. [63.3; 63(54).]

Piper, C. V.—Forage Plants and Their Culture. Revised Edition. (695 pp.) New York and London: Macmillan, 1924, 18s. net. [63.33.]

Seale-Hayne Agricultural College.—Pamphlet 13:—Variety Trials with Oats, 1920-24. (12 pp.) Newton Abbot, Devon, 1924. [63.314.]

Plant Diseases.

Marchal, E.—Eléments de Pathologie végétale appliqué à l'Agronomie et à la Sylviculture (328 pp.) Gembloux: Jules Duculot, 1925, 30 fr. [63.2.]

Dairying.

Judkins, H. F.—The Principles of Dairying.—Testing and Manufactures. (296 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 10s. [63.70.]

Lord, L. J.—Practical Butter and Cheese Making. (200 pp.) London: Ernest Benn, 1925. Paper Covers, 7s. 6d.; cloth, 10s. 6d. [63.72; 63.73.]

Lancaster County Council.—Agriculture, Leaflet 21:—Rations for Dairy Cows. (12 pp.) Preston, 1924. [63.711 : 043.]

Seale Hayne Agricultural College.—Cost of Food in Milk Production in Devon and Cornwall. 2nd report, November, 1923, to March, 1924. (10 pp.) Newton Abbot, 1924. [63.714.]

Ohio Agricultural Experiment Station.—Bull. 376:—Effect of High and Low Protein Content on the Digestibility and Metabolism of Dairy Rations. (pp. 85-116.) Wooster, 1924. [63.711 : 043.]

Missouri Agricultural Experiment Station.—Research Bull. 66:—The Minimum Protein Requirement for Growing Heifers. (155 pp.) Columbia, 1924. [63.711 : 043.]

International Institute of Agriculture.—Milk and Milk Products: Statistical Survey of Production and Trade. (145 pp.) Rome, 1924, 4s. [63.7(00); 63.70 : 38.]

Poultry and Bees.

New Jersey Agricultural Experiment Station.—Bull. 402:—Seasonal and Annual Egg-Production Correlation. Tables. (15 pp.) New Brunswick, 1924. [63.651.]

California Agricultural Experiment Station.—*Bull.* 378:—Studies on a Nutritional Disease of Poultry caused by Vitamin A Deficiency. (22 pp.) Berkeley, 1924. [619.5.]

Michigan Agricultural Experiment Station.—Special Bull. 135:—Seasonal Management for Commercial Apiaries. (58 pp.) East Lansing, 1924. [63.81.]

Economics.

Norman, J. B.—Farm Credits in the United States and Canada. (420 pp.) New York and London: Macmillan, 1924, 15s. net. [332.71(71); (73).]

Taylor, A. E.—Co-operative Production and Marketing. (6 pp.) Food Research Institute, Stanford University, California, 1924. [334.6.]

App, F.—Farm Economics, Management and Distribution. (700 pp.) Philadelphia and London: J. B. Lippincott, 1924, 10s. 6d. [338.1.]

Warren, G. F., and *Pearson, F. A.*—The Agricultural Situation: Economic Effects of Fluctuating Prices. (322 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 15s. net. [338.1(73); 338.5.]

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SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

Greenhouse Experiments with Atmospheric Nitrogen Fertilizers and Related Compounds, *F. E. Allison et al.* (Jour. Agr. Res., xxviii; 9, (May 31, 1924), pp. 971-976.) [63.1671.]

Basic Slags and Mineral Phosphates. The Ratio: Soluble Phosphoric Acid/Total Phosphoric Acid, *E. Vanstone.* (Jour. Agr. Sci., xv, 1 (Jan., 1925), pp. 36-46.) [63.1672.]

Field Crops.

The Growing of Crops for Silage and some Experimental Results, *J. P. Drew.* (Jour. Dept. Lands and Agr. (Dublin), xxiv, 3, (Nov., 1924), pp. 228-236. [63.19832; 63.60432.]

Experiments and Observations on Forms and Strains of *Trifolium repens*, L., *W. M. Ware* (Jour. Agr. Sci., xv, 1 (Jan., 1925), pp. 47-67.) [63.33(*b*).]

Spring Cabbages: Tests of a Number of Varieties. (Jour. Dept. Lands and Agr. (Dublin), xxiv, 3 (Nov., 1924), pp. 248-251.) [63.511.]

Plant Pests and Diseases.

Further Experiments in the Control of Certain Maggots Attacking the Roots of Vegetables, *K. M. Smith.*

A Disease of Wild White Clover caused by the Eelworm, *Tylenchus dipsaci* (Kühn) Bastian, *W. M. Ware.* (Ann. App. Biol., xii, 1 (Feb., 1925), pp. 77-92; 113-119.) [63.27.]

Aphides Attacking Vegetables and Market-Garden Crops, *F. T. Theobald.* (Jour. Roy. Hort. Soc., 50, 1 (Jan., 1925), pp. 28-45.) [63.27.]

The Resistance of Oat Varieties to Stem Rust, *W. W. Mackie* and *R. F. Allen.* (Jour. Agr. Res., xxviii, 7 (May 17, 1924), pp. 705-720.) [63.24.]

The Relation of Leaf and Other Diseases of the Potato Crop. *D. C. Cuthbertson.* (Jour. Roy. Hort. Soc., 50, 1 (Jan., 1925), pp. 21-27 + 10 pl.) [63.23-33; 63.24-33.]

Infection Experiments with Wart Disease of Potatoes, *Synchytrium endobioticum* (Schilb.) Perc., *M. D. Glynne.* (Ann. App. Biol., xii, 1 (Feb., 1925), pp. 34-60.) [63.24.]

Dégénérescence de la Pomme de Terre: Théorie mycorhizienne et sélection, *V. Ducomet.* (Ann. Ecole Nat. Agr. Grignon, viii (1921-22), pp. 96-136.) [63.23-33.]

A Preliminary Study of the Relationship between Manuring and Susceptibility to Disease in Potatoes, *H. W. Miles* and *B. Thomas.* (Jour. Agr. Sci., xv, 1 (Jan., 1925), pp. 89-95.) [63.512-16; 63.23-33; 63.24-33.]

Experimental Study of the Fungal Invasion of Apples in Storage, with particular reference to Invasion through the Lenticels, *M. N. Kidd* and *A. Beaumont.* (Ann. App. Biol., xii, 1 (Feb., 1925), pp. 1-33, pl. i and ii.) [63.24-41.]

Live Stock.

The Feeding of Pigs, *E. J. Sheehy.* (Jour. Dept. Lands and Agr. (Dublin), xxiv, 3 (Nov., 1924), pp. 237-242.) [63.64 : 043.]

Digestion Trials with Swine, *H. E. Woodman.*

ii. Comparative Determinations of the Digestibility of Dry Fed Maize, Soaked Maize, Cooked Maize and Flaked Maize.

iii. Digestibility of a Coarse Grade of Middlings.

iv. Note on the Digestion of Whole Milk by Swine.

(Jour. Agr. Sci., xv, 1 (Jan., 1925), pp. 1-25.) [63.64 : 043.]

Vitamins in Stock Feeding, *J. B. Orr.*

Vitamins in Agriculture, *J. Golding.*

(Agricultural Progress, ii (1925), pp. 7-14; 14-17.) [612.394.]

The Chemistry of Vitamins, *A. Seidell.* (Science (Nov. 14, 1924), pp. 439-447.) [612.39.]

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The Optimum Quantity of Roots for High-Yielding Cows, *J. Wilson.* (Jour. Dept. Lands and Agr. (Dublin), xxiv, 3 (Nov., 1924), pp. 223-227.) [63.711 : 043.]

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Studies in Dairy Farming. i. Extensive and Intensive Methods in South Cheshire. ii. Milk Production in an Industrial Area, *W. B. Mercer* and *W. A. C. Carr.* (Agric. Progress, ii (1925), pp. 17-24.) [63.711.]

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